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DEVOTED TO THE INTERESTS OF ARCHITECTVRE IN MATERIALS OF CLAY

PUBLISHED MONTHLY.

85 WATER STREET, BOSTON, MASS.

VOLVME FIVE

JULY MDCCCXCVI

NVMBER SEVEN

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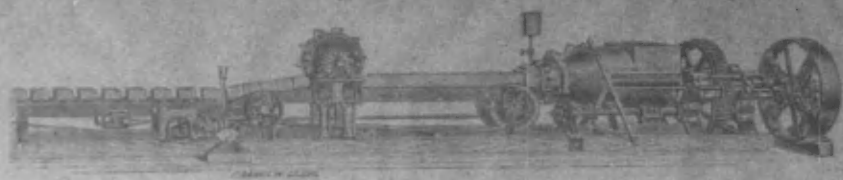

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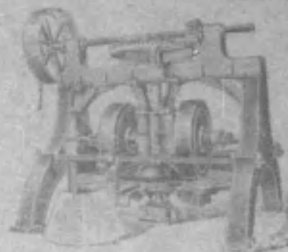

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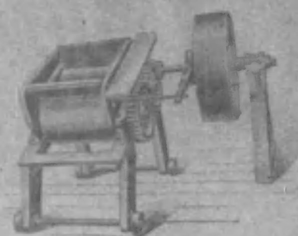

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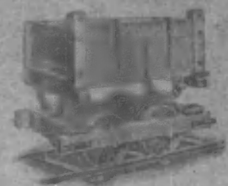

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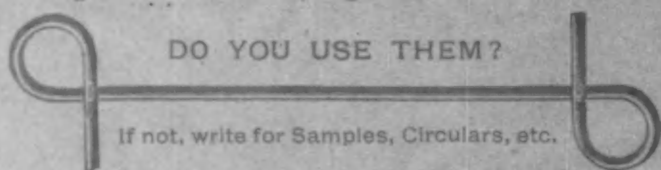

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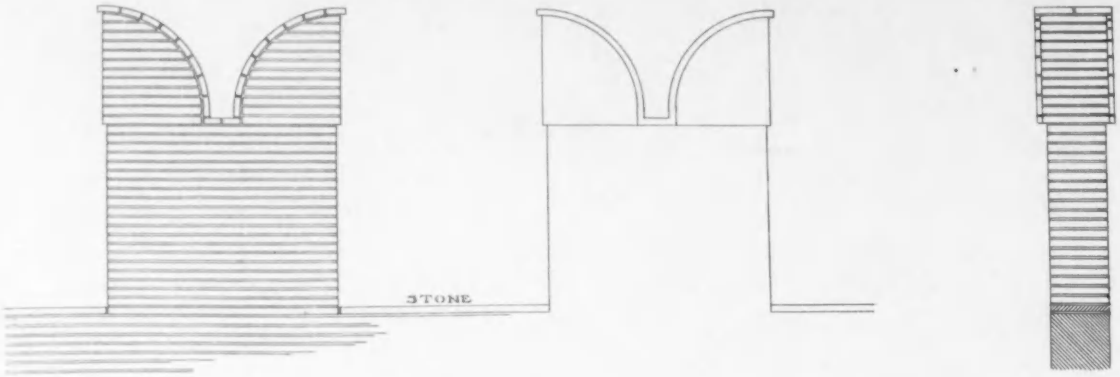

ELEVATION

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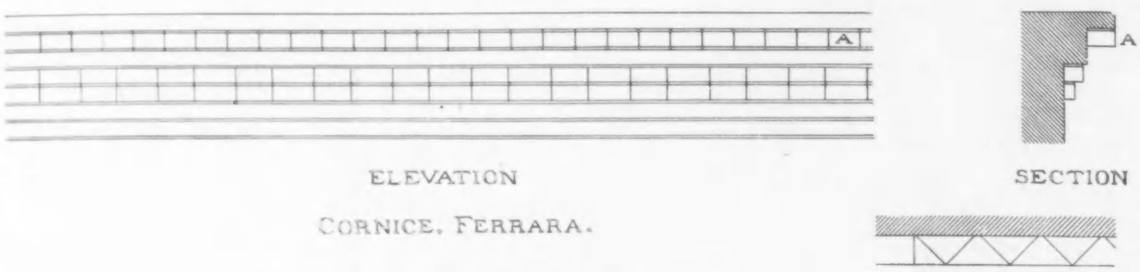

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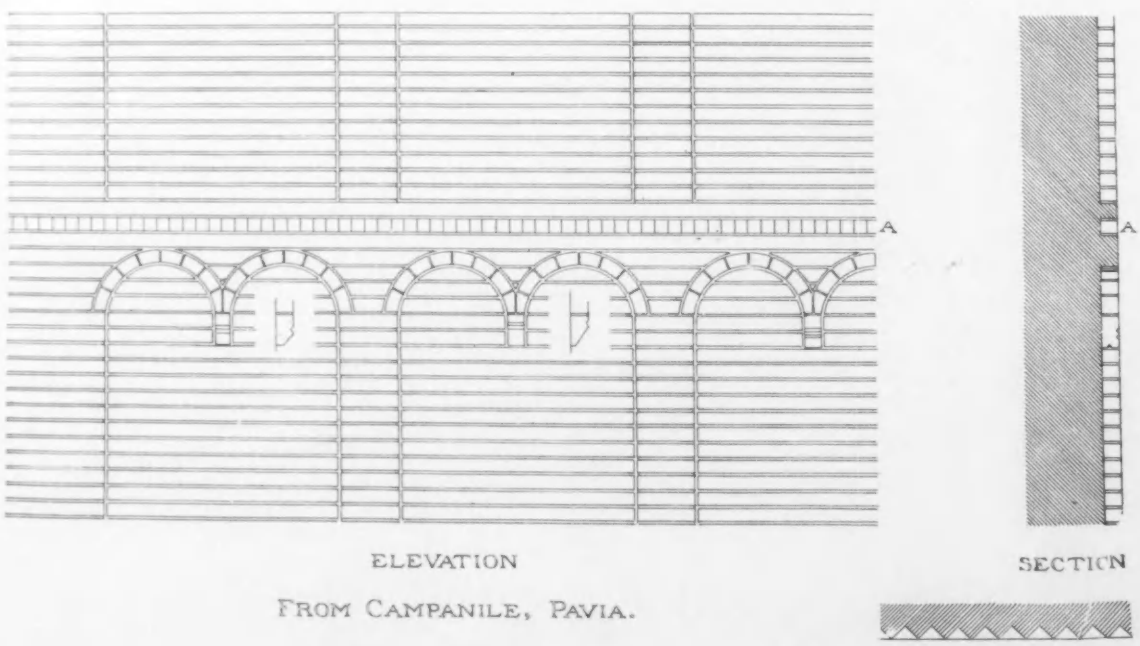

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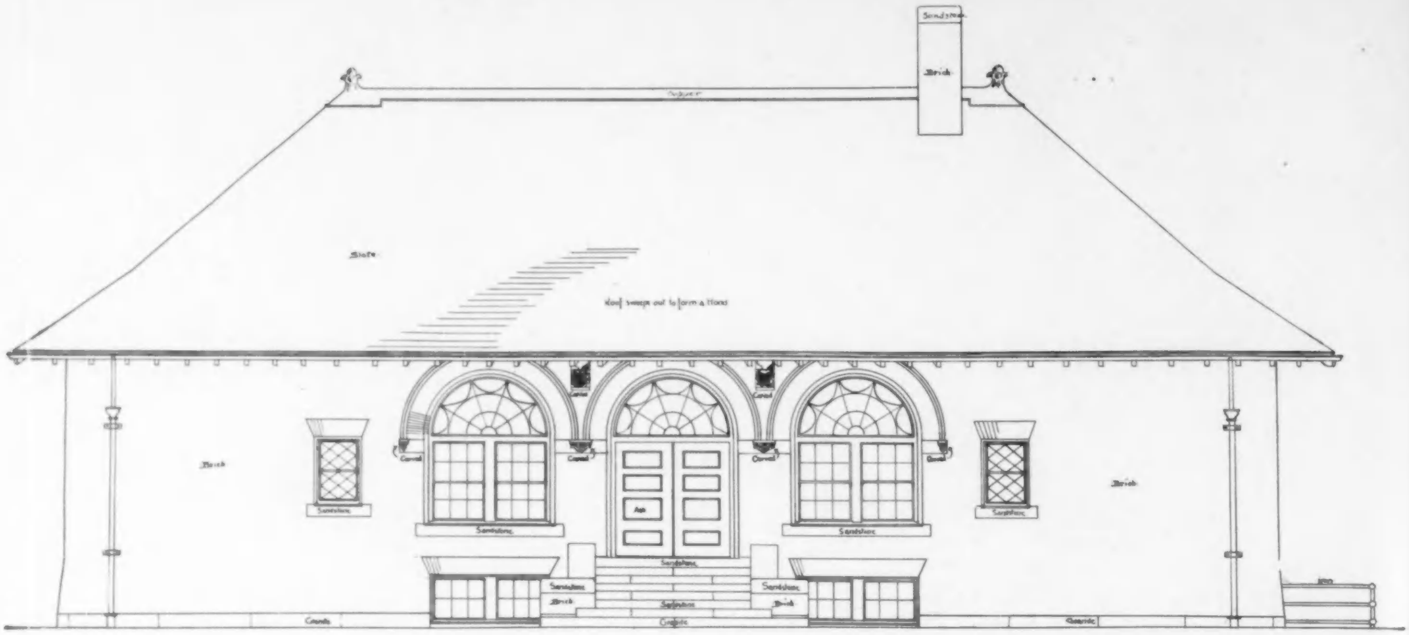
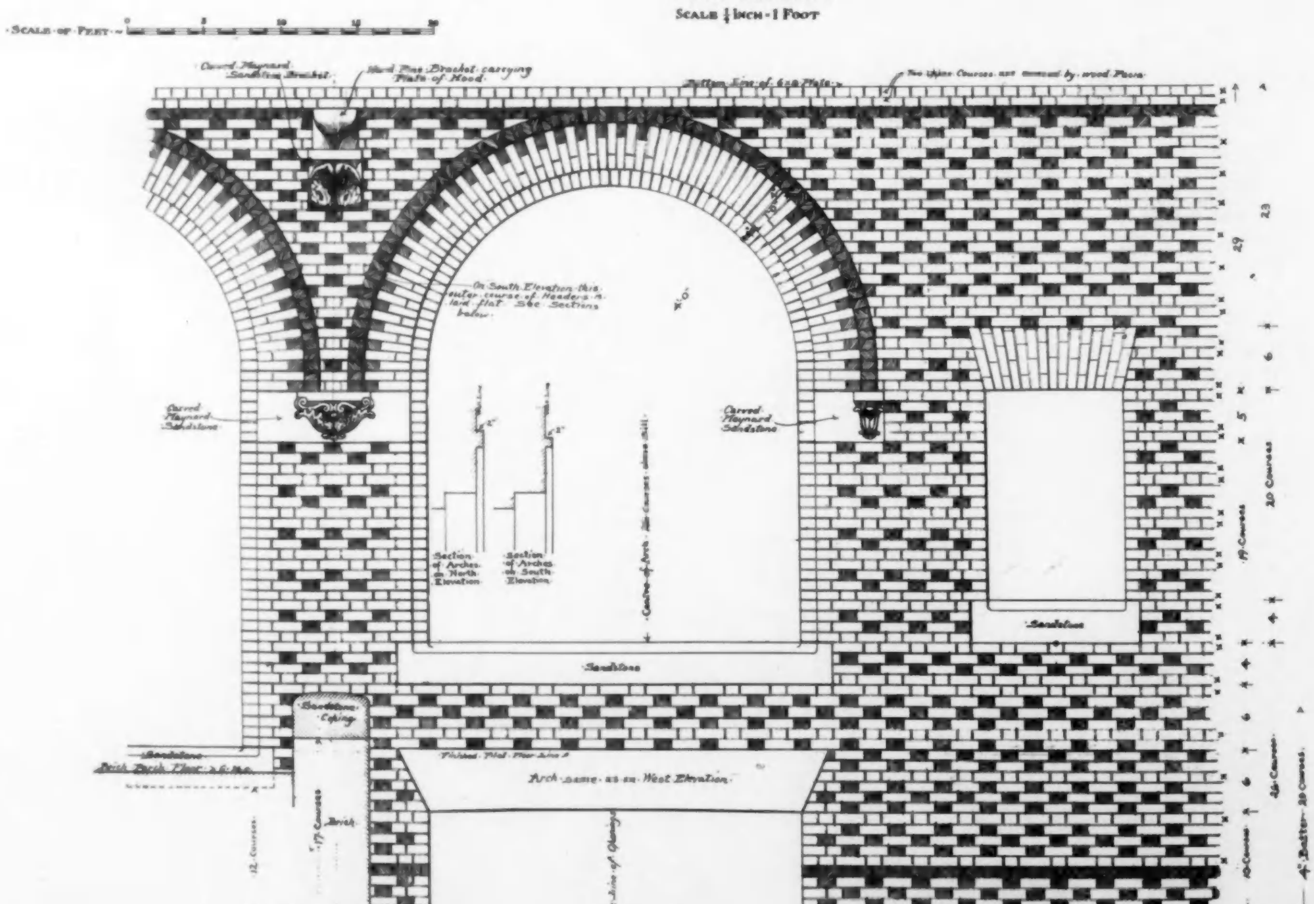


North Elevation

Scale ¼ Inch - 1 Foot



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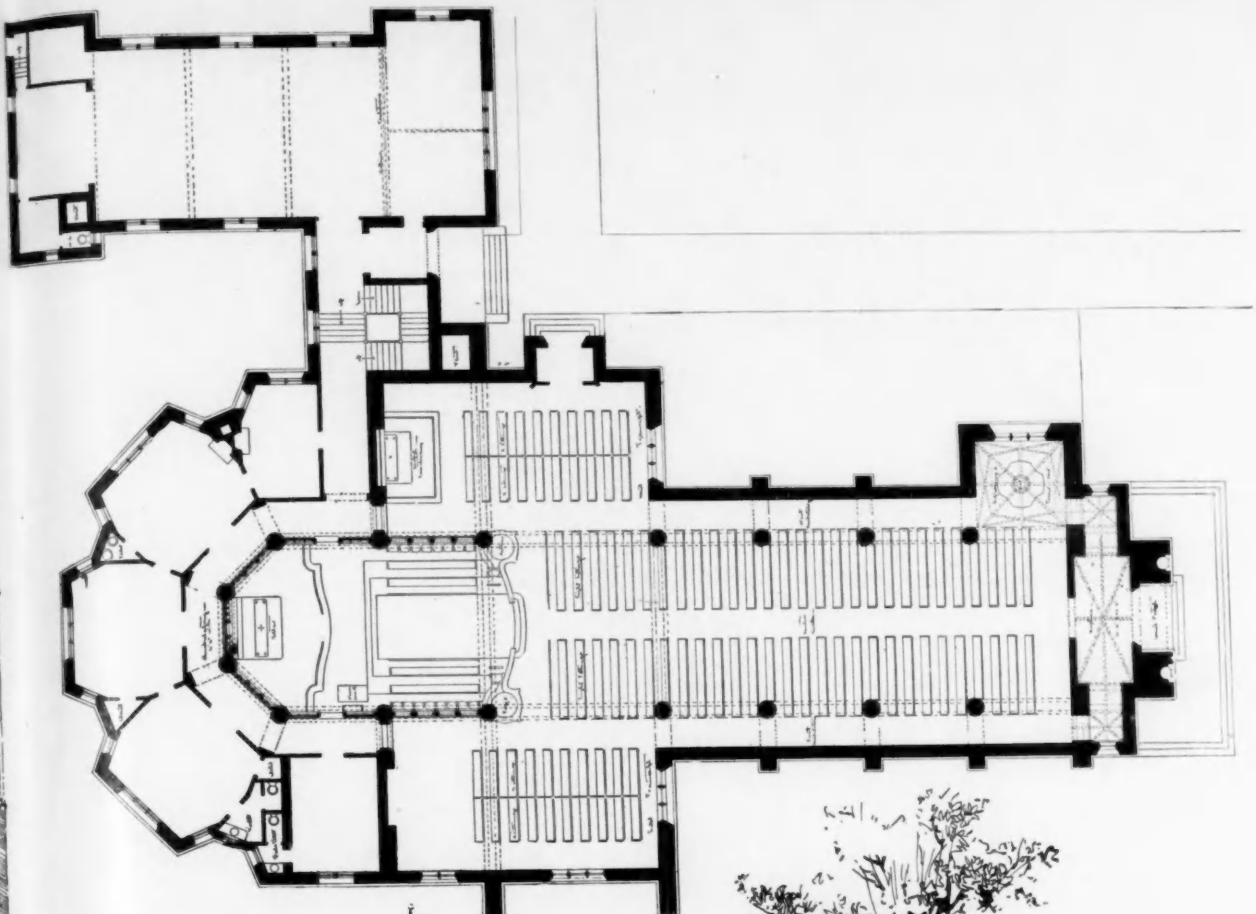
VOL. 5. NO. 7.

COMPETITIVE DESIGN, ST. PAUL'S (
CRAM, WENTWORTH & GO



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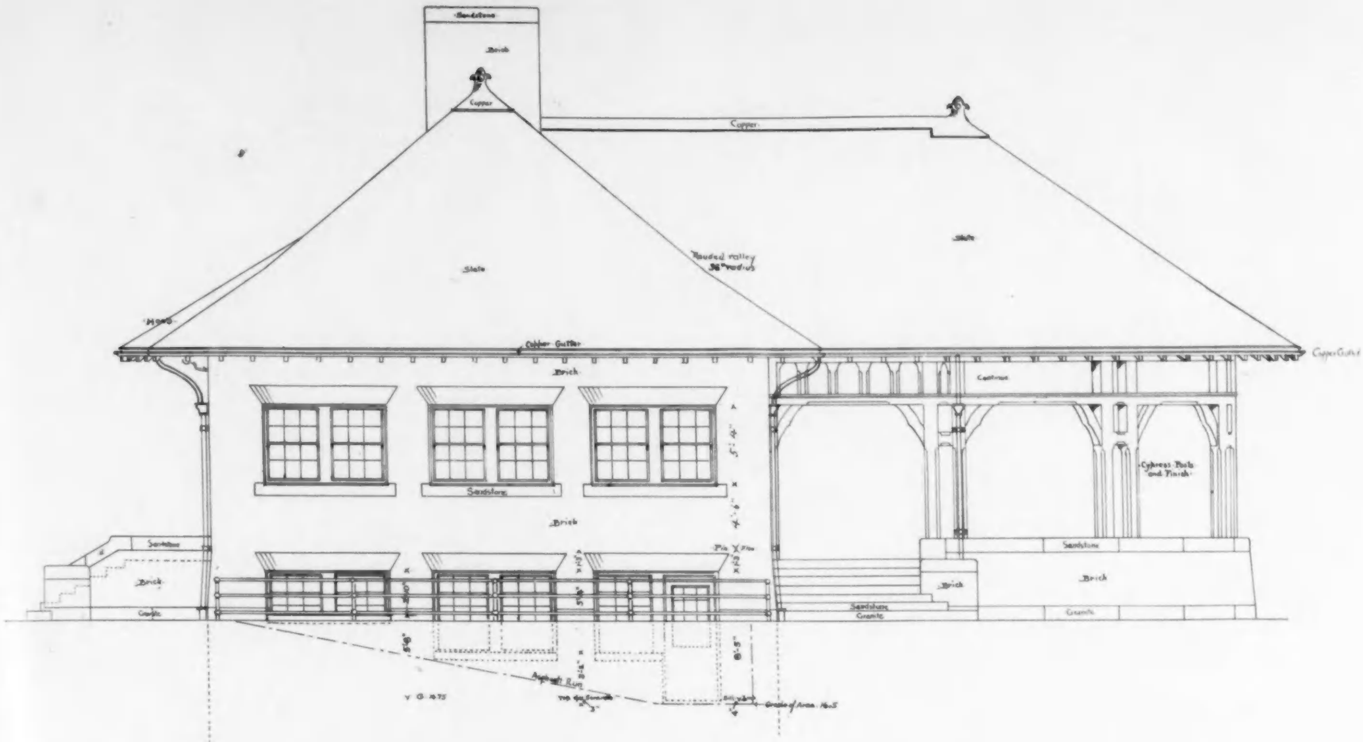
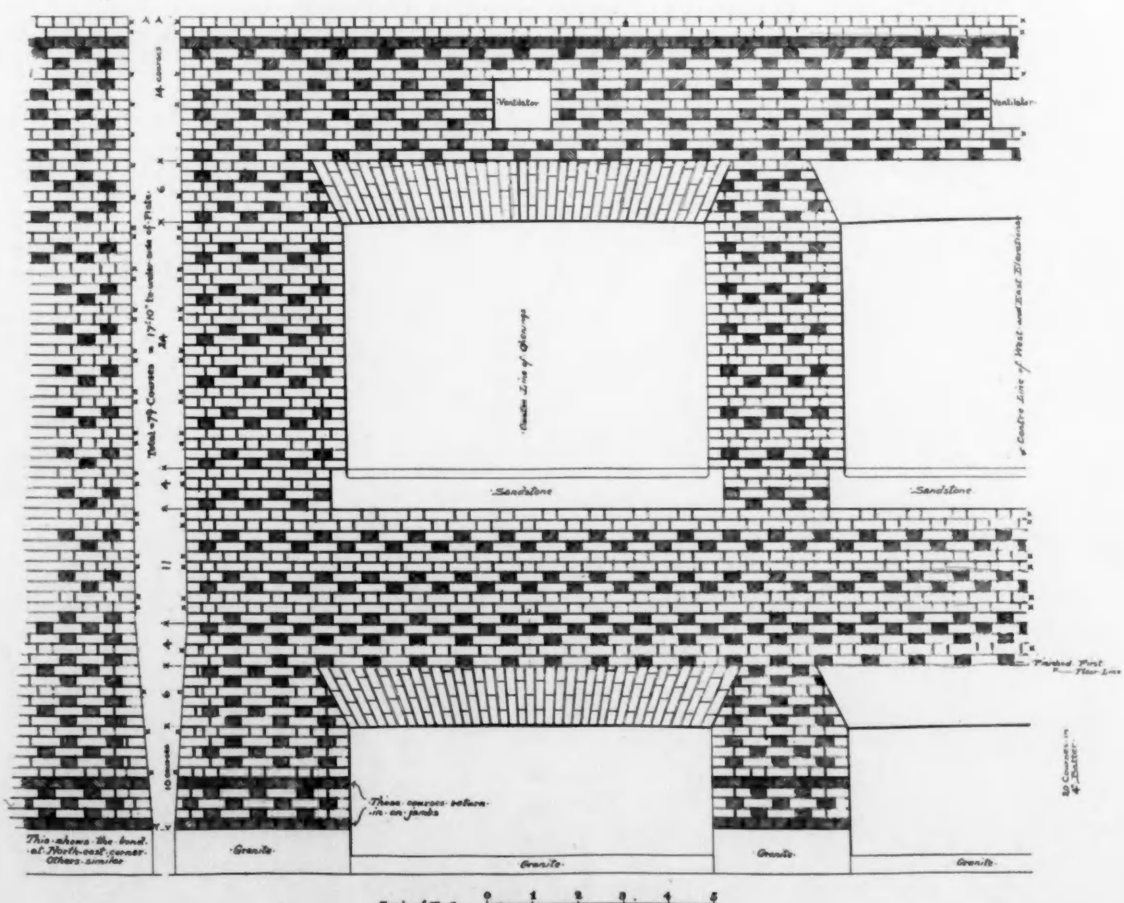


WEST ELEVATION
SCALE $\frac{1}{4}$ INCH = 1 FOOT



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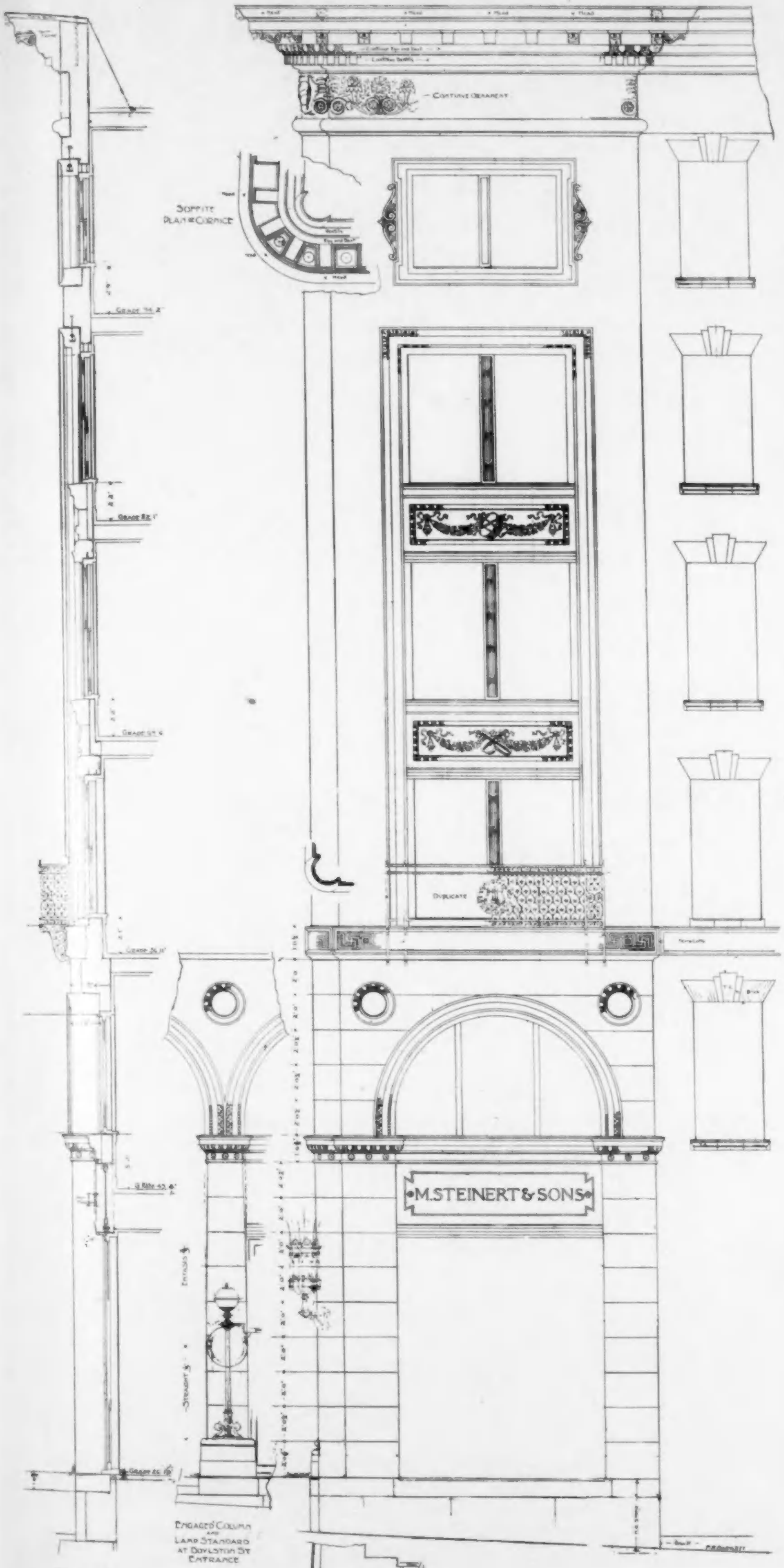
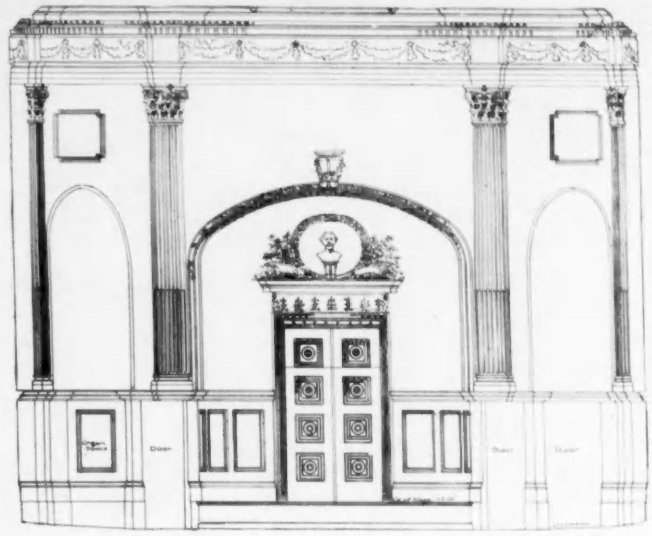
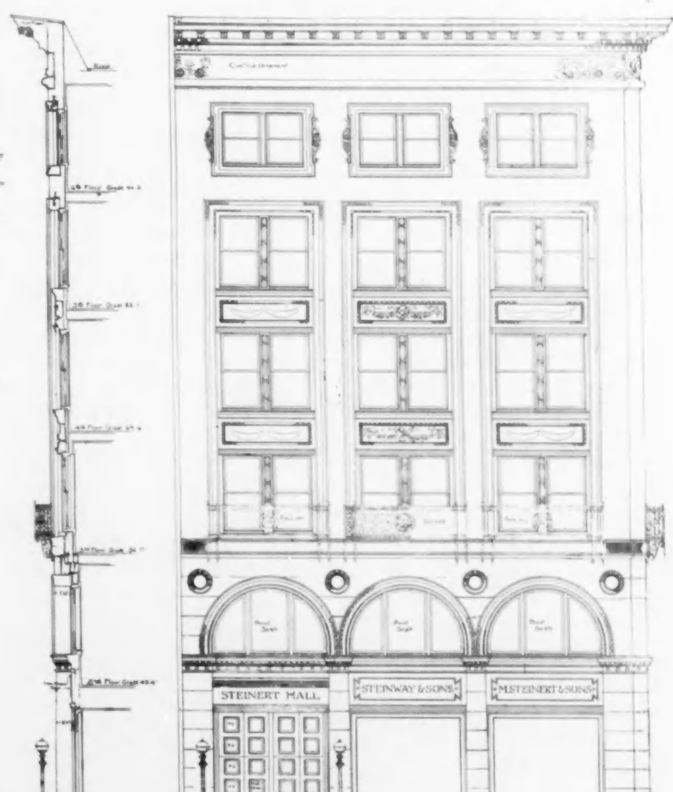




INTERIOR VIEW, LOOKING
TOWARD STAGE.



FRONT ELEVATION.

STEINERT BUILDING, BOSTON. WINSLOW & WETHERELL, Architects.

VOLVME V JULY 1896 No. 7

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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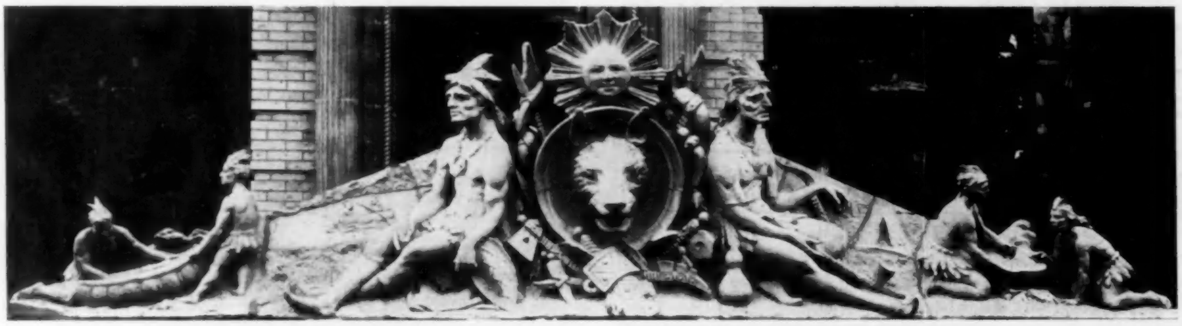
BRICK FOR COUNTRY HOUSES.

ONE of our contemporaries published some time since an editorial regarding what it was pleased to designate as the blighting influence of brick architecture, expressing a hope that the brick age would not reach the country, and that our suburbs might be spared the infliction which was assumed to be a necessary concomitant of the use of brick. An expression of this sort is manifestly based upon very weak arguments, for where brick is used in an uninteresting manner the fault is not with the material nor its implied surroundings, but with the individuals who did not know how to rightly design or place it. Indeed, we would be inclined to turn the words of our contemporary around and express the hope that the untoward influence of our wooden shanties may soon cease to affect the designing of our city houses; that the age of wood, having served its purpose, may be superseded by a period wherein our country houses no less than our city dwellings may receive a fair attention, and permanence and fitness of material be considered quite as much as mere beauty of color or form. We, as a nation, may feel justly proud of what has been done in the past with our wooden houses. We have evolved from the primitive clapboard or shingle hut of our New England ancestors a style of wood architecture which is unique, appropriate, and in many ways very fully answers our needs, but it has all the defects of the material employed. There are many instances of wooden houses which have outlived successive generations, but no one, we believe, will question the greater durability of brick and stone over anything which could be expected of shingles and studding. Wood has been so cheap in this country that it is the exception to find anything else employed for a country house. The exceptions, however, are sufficiently numerous and successful to show to any candid observer how much more satisfactory a brick house can be than one which is built entirely of wood, as, for examples, the delightful old brick house on the main street of Weymouth, or the charming brick houses at Salem. Because there have been miles of barren, uninteresting city houses erected without design, and without reason, we cannot argue that necessarily all brick houses are to be built after the same standard. There are very few effects attainable in a wooden house which cannot be improved upon in nearly every sense by the employment of brick. Wood has a proper function in conjunction with masonry. We can use it to advantage for our roofs and for our finish, but the house which is to be cool in summer, warm in winter, standing the wear of the elements in such a manner as to improve in appearance each year rather than lose, must be built of brick or stone. We come across such houses occasionally in unexpected parts of this country. In the neighborhood of Trenton there are a few delightful old masonry houses, cottages they would be called in England, which are far preferable in every respect to any of our shingled castles. Again, the best of the Virginia and Maryland houses are constructed almost without exception in brick, and throughout New England there are a number of very interesting, picturesque, and livable brick country houses. Indeed, we are inclined to believe, if the work of this country previous to the year 1830 were to be considered, it would be found that our best country houses, those which most commend themselves to the judgment of the artist as well as to the practical constructor, are built of brick. We have had occasion in these columns to refer to the use which the English and the Dutch are able to make of brick, and have noted the remarkably successful results of their efforts. We never think of an English cottage as being constructed of anything but masonry, and wood as a building material is relatively almost unknown in Holland; and yet probably nowhere else in the world can there be found such charming, picturesque, homelike dwelling-places as in these two countries. The use of any one material in itself will not create a national style nor insure excellence of production, but if in this country we should once fairly set the fashion of using brick for our country houses, in a short while we would look back in amazement at the years of persistent effort persuade ourselves that a shingled house would answer every requirement of a summer residence. The picturesque qualities which we admire are certainly well brought out in our wooden constructions, but all of them, and far more, are possible with brick. We ought to take the good points of our wooden architecture, its overhanging eaves, strong shadows, broad roof surfaces, and quiet masses of color, and combine with these the depth of reveal, the appearance of stability and strength, the restful tones of the brick, and the added warmth and coolness for winter or summer, which are possible with masonry. There is no reason why our country houses should not be fully as picturesque and enjoyable as those in England; though in this connection we must bear in mind that the English pay attention to the externals of a house to an extent with which we are very little familiar. Our average country house has, perhaps, a honeysuckle or wisteria climbing over the porch, a few rose-bushes at one side, no fence in front, and a patch of lawn which can be used for tennis for the edification of all passers-by. The Englishman or

Dutchman, on the other hand, builds his house to last for generations, sets it back from the street, surrounds it with plants, shrubs, and flowers, serving the double purposes of adornment and concealment, and making the English country house or the Dutch villa a charming place of residence which we admire but do not seriously try to imitate, or at least when we do imitate it, we are so reluctant with our projections, so sparing with our detail, or so insufficient in our surroundings, that the result is barren and uninteresting, simply because we do not half do our business. Architecture in this country has evolved itself from the hut upward in distinction to the rule in Europe, where the evolution has been from the palace downward, and our wooden country houses show all the marks and limitations of their origin, while we cut ourselves off from a great deal of the enjoyment which our foreign cousins are able to derive from a solid, substantial, and yet picturesque and homelike brick structure. There need be nothing barren about a brick house except the emptiness of ideas on the part of the designer.

ILLUSTRATED ADVERTISEMENTS.

THE adjoining illustrations of two tympana are from the Lake and Church Streets elevations of the new City Hall, Elmira, N. Y., now approaching completion, and of which Messrs. Pierce & Bickford, of Elmira, are the architects. Some aspects of life among the Indians in that part of the State, and of which this valley was once a favorite habitation, are depicted on the Lake Street pediment. The head of the wolf, that animal being the totem of the Senecas, is placed in the center. To the one side the good man of the house, surrounded by his Lares and Penates, enjoys the pipe of (in this case) domestic peace, while his squaw and, presumably, her eldest daughter, grind sufficient corn for breakfast. On the other side sits a stalwart brave amidst implements of war and of the chase. Two other figures towards the river's brink launch a canoe with the apparent intention of joining the boating party seen in the distance, and from this it may be inferred that the champion oarsmen of the Six Nations are having a gala day on the Chemung.



Let the imagination leisurely fill in the details of the picture, for in walking around to Church Street something over a hundred years have elapsed. What a transformation! Liberty sits enthroned with the Stars and Stripes for a background. The emblems of her defense are brought into view, and between them the eagle screams. The spread of learning and the advancement of science and art are well represented on one side, while the mechanical and agricultural industries, with which are allied trade, commerce, and locomotion, are symbolized on the other.

Mr. Louis Roncoli, Italian by birth, artist by instinct, and American by preference, was the modeler. He has been with the New York Architectural Terra-Cotta Company for ten years, and has conceived as well as executed many subjects of merit, some of which have appeared in THE BRICKBUILDER.

In the advertisement of The Celadon Terra-Cotta Company, Charles T. Harris, Lessee, on page xxvi, is illustrated the high school building at Kingston, Penn., of which F. L. Olds is the architect.

BARTA PRESS COMPETITION. JUDGES' AWARD.

THE gentlemen who acted as judges in the Barta Press Competition, Messrs. C. Howard Walker, R. Clipston Sturgis, and Bertram G. Goodhue, have awarded the five cash prizes as follows: First prize, \$50, L. Eugene Jallode, 52 Broadway, New York; second prize, \$25, Peter Brust, St. Francis, Wis.; third prize, \$15, Louis Sonntag, 320 Walnut Street, Philadelphia; fourth prize, \$10, Francis S. Swales, Rochester, N. Y.; fifth prize, \$5, Alfred F. Shurrocks, 75 Westminster Street, Providence, R. I.

The report of the judges and the successful designs will be published in our August number. At the time of going to press Mr. Barta had not made his selection of the designs for which special prizes were offered. This list also will be published in our August number.

REGARDING the drawings published in the plate pages of THE BRICKBUILDER, we would state that they are always of buildings constructed principally, if not wholly, of brick or terra-cotta, or both. This statement is made for the reason that on many of the drawings published there is nothing to distinguish them from stone or wooden buildings. This is largely due to the fact that we use mostly scale drawings rather than perspectives. It is our purpose to publish, in connection with elevations, such details of brick or terra-cotta as we think will be of interest, although, as is generally appreciated, a building may have a very interesting treatment without being enriched by elaborate detail.

Spanish Brick and Tile Work. II.

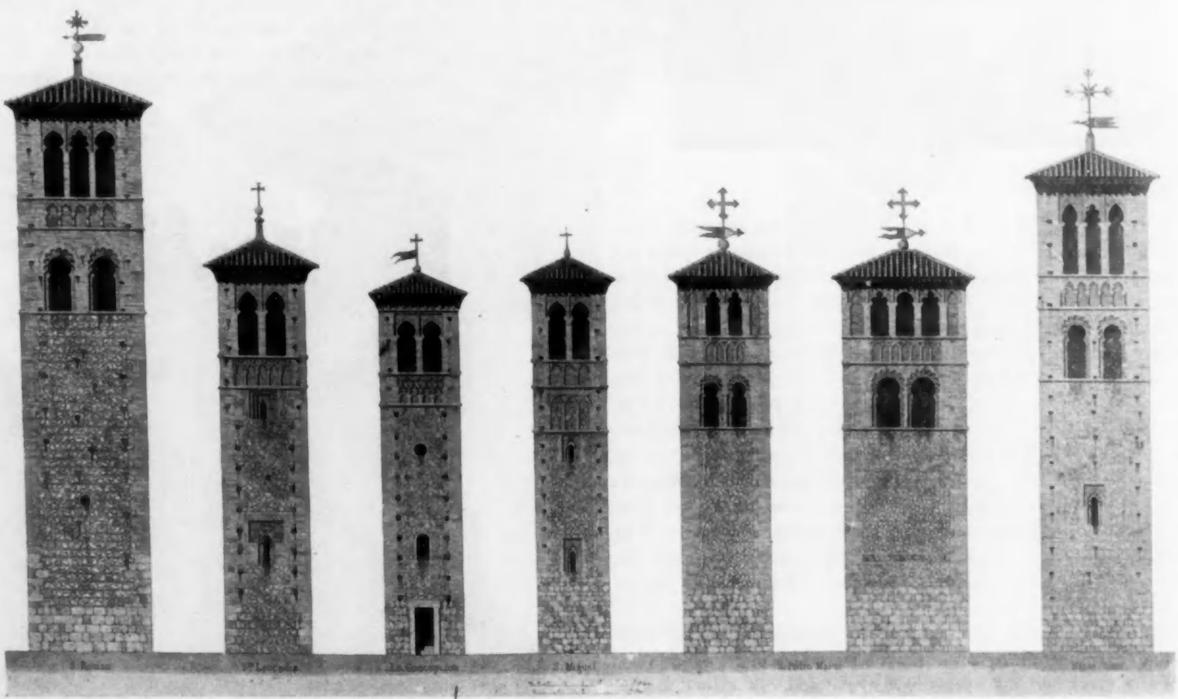
BY C. H. BLACKALL.

TOLEDO is in many respects the most fascinating city in Spain. For nearly three hundred years it was the capital of the mightiest of the Hispano-Moorish kingdoms, and when the Moors were driven to Cordova, Toledo became the center of Christian civilization, and was for centuries the first city of the land, with a population exceeding 200,000, and a vitality in art and industry which is hard to appreciate now. The Bishop of Toledo was the primate of Spain, and the arts and sciences were there cultivated to the highest point during the golden era of Spanish rule. The removal of the capital to Madrid began the work of slow decay, which has lasted ever since.

If the imaginative qualities are an important essential of good architecture, surely all architects ought to visit Toledo. The city is built on a peninsula enclosed by the Tagus on three sides. The precipitous cliffs rise abruptly from the ragged water's edge, and are connected at points to the opposite shore by picturesque bridges dating from way back into the time of the Romans. The city itself is a maze of narrow, tortuous streets, hardly one of which is wide enough for a wagon to be drawn through. The Cathedral and the Alcazar dominate the irregular mass, and scattered all through in unexpected corners and forgotten by-paths are fragments of architectural remains from the successive generations which have occupied and built over Toledo. There is very little which has been preserved intact. Nearly every monument has been restored, altered, or rebuilt at different periods, and the result is a conglomerate which has to be taken in detail in order to appreciate how much architecture has been crowded into this narrow little city at different times. Indeed, we can only faintly appreciate the magnificence which must once have been the rule in opposition to the neglect and decay which is everywhere now so apparent.

The brickwork of Toledo is almost entirely Moorish in its origin. When brick was employed by the Spaniards in later periods, it was invariably covered over with a thick layer of stucco, and brick as such is very little found in the later work. What remains of the Moorish brickwork in Toledo deserves a more careful study than it usually receives, as, notwithstanding its fragmentary and disappointingly scattered condition, it is unique of its kind. Of the works dating from the time of the Moorish rule very little remains, and even that has been so altered and built upon as to be of little actual value. The Christian conquerors doubtless made it a point of honor to destroy the monuments of their infidel foes, but the genius of the subjugated race long survived defeat and found free employment in the churches and shrines which were built for their captors. Hence we find here, as in Saragossa, that the Moorish style is expressed in the Christian churches. Indeed, this style, which the Spanish designate as Mudejare, endured even after the Moors were expelled from the country, for up to the fifteenth century nearly all of the better artisans and architects were of the fallen race.

There are scattered through the city a score or more church towers in which the Moorish origin is very strongly marked. All of these are graceful in proportion and generally delicate and appreciative in detail. The accompanying illustration, showing a number of these, is taken from the superb work published by the Spanish Government, entitled "*Monumentos Arquetectonicos de España.*" In the reproduction the towers are shown in perfect condition, though they are actually in a sad state of decay. In all of these towers it will be noticed that the construction is of rubble stone bonded by regular courses of brick, and with brick quoins and finish. In none of these are the wall surfaces treated with the delightful fretted ornamentation noticed in the Saragossa towers. The brick is really used with an intelligent appreciation of constructive practicability, which is usually conspicuous by its absence in Moorish work. In these towers the scaffold holes are frankly admitted and play a considerable part in the effectiveness. The brick is deeper in tone than that used in Saragossa, although it is far from being as red as in some of the Seville buildings which we shall study next. Possibly the Moors would have plastered the rubble with white stucco. This quoin treatment combined with coursed rubble seems to be peculiar to



TOLEDO TOWERS.

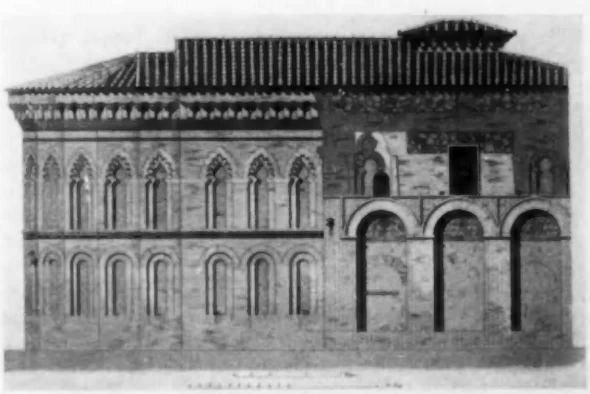
Toledo. It is certainly an essentially Spanish feature, and finds a later and more florid development in Seville, and to a slight degree in Mexico.

One of the most prominent remains is the Puerta del Sol, which

SANTIAGO DEL ARRABAL.

was one of the city gates and is only in part of brick, the bulk of the construction being of rubble masonry, but the ornamental parts are treated entirely with brick. The design of the central motive is admirable. The driveway is small, as is the case with all of the Moorish gates, but the monumental effect is enhanced by the double horseshoe arch and enriched by the double blind arcade of brick above the center. It seems so easy to do a piece of work of this sort, when looking at the photograph, that one is naturally led to wonder why our attempts at reviving this Moorish style in brickwork have been such complete failures. The only explanation is that the connection between the construction and the decoration in Moorish work was extremely attenuated, and the design was carried out in so subtle a vein that when we undertake to apply the same motives to our present necessities, we miss the intangible bond which united the Moorish work so cleverly and makes it seem so thoroughly appropriate for its place and its functions.

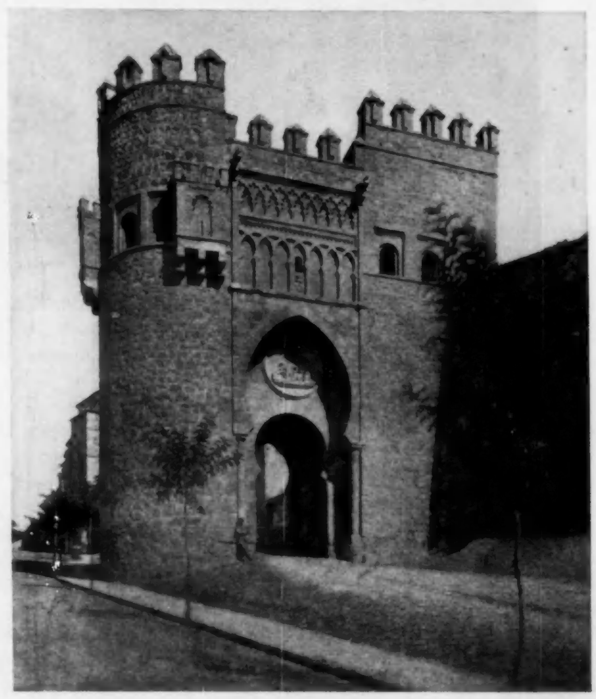
The Parish Church of Santiago del Arrabal is another very interesting example, dating from 1247. Here the interest lies very little in the mass, and not specially in the detail, but rather in the



SANTO CHRISTO DE LA LUZ.

manner in which plain brickwork has been combined to produce an effect. The masonry is in the main of rubble, with brick quoins, brick window finish, cornices, and chimneys. The brick is laid with very heavy joints, quite as thick as the bricks themselves. The action of time has washed away a great deal of mortar from the joints, so that the wall surfaces, instead of being unbroken, are cut up by the recessing of the joints, adding very materially to the effect. The design of the gable end, with its chimneys brought in harmoniously, and the projecting tile eaves, is very pleasing and is worked out in an admirable manner. The tower is manifestly unfinished. I do not remember that this open joint effect has ever been tried in a modern building, but it offers an opportunity of escape from our stereotyped methods of brick laying which in the right hands ought to lead to very interesting results. It would hardly be successful with our ordinary brick, but with the long, flat shapes which the Moorish designers employed it would be thoroughly appropriate.

In an out-of-the-way corner of the city, close by the crumbling old city walls, is an antiquated, weather-beaten brick structure which has an interesting history. It was originally intended for a Mohammedan mosque and was built in the early period of the Saracenic domination, presenting the Arabian architecture at the time when the remains of the Roman and early Christian arts had been assimilated in a measure by the invaders. The older portions date from about 850. When the city was captured by the Christians in 1085, the first mass was celebrated in this building, which was cleansed and dedicated to Santo Cristo de la Luz. The Hospitallers of St. John held it from 1156 to 1843, during which time it was often repaired and



PUERTA DEL SOL.

mutilated, notably by Mendoza in the fifteenth century, though the character of the design has not been materially altered, and all the changes were carried out in the Moorish spirit, so that here are shown the earliest and the latest manifestations of Oriental Spanish architecture.

A long visit would not exhaust the possibilities of Toledo. Diligent research would doubtless reveal many charming bits of Moorish brickwork lining up the walls of dilapidated *patios* or hidden under heavy coats of dingy stucco. Only a little is available for actual study.

(*To be continued.*)

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

CHAPTER III.

CONSTRUCTION IN WOOD.

GENERAL REMARKS ON THE METHODS IN USE AMONG THE ROMANS.

WOOD had so large a place in Roman construction that it is impossible for us to pass without reviewing their methods of framing. Unfortunately, the questions concerning them are very difficult to answer; the ruins themselves furnish but few indications of the proper solutions; and manuscripts, too incomplete or too vague, throw but little light on the methods which we have the greatest interest in knowing. An enumeration of the pieces of a truss by Vitruvius, some short notices of a small number of celebrated pieces of framing, such as the bridge over the Rhine, a sketch of the bridge over the Danube, a summing up of the framing in the basilica of Fano, and the details of a Tuscan truss, and of a pent-house at Pozzuoli; such is the inventory of the documents that remain. On such foundations one cannot build a satisfactory theory, and we will content ourselves with presenting as examples some of the descriptions whose graphic translations will involve the fewest conjectures or hypotheses.

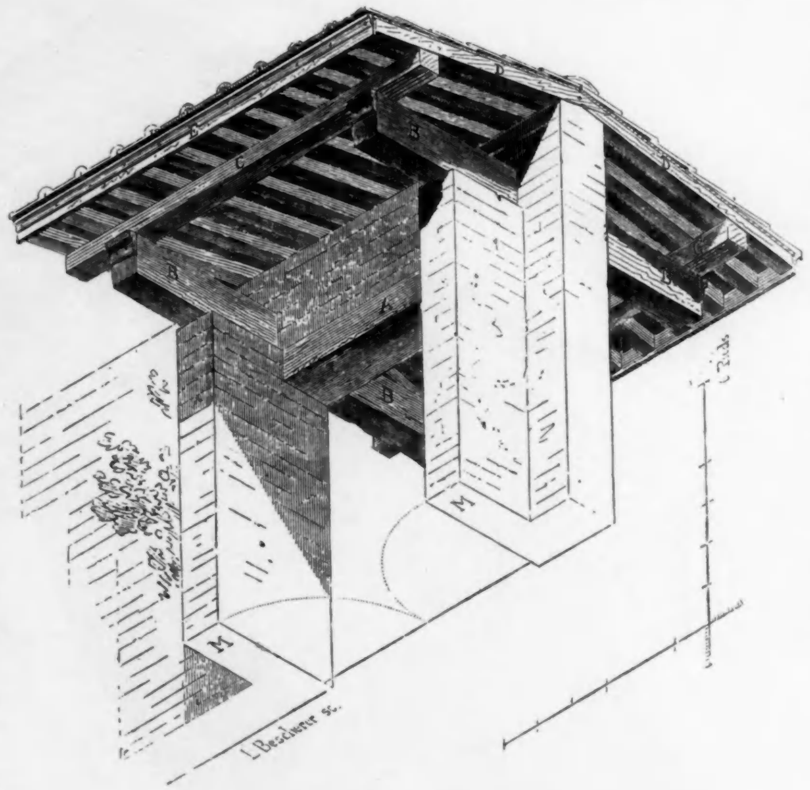


FIG. 85.

Of all the examples of ancient framing, the shelter at Pozzuoli is the one whose arrangement is the most exactly known; the description of its construction was engraved on marble,[1] and the aspect of this modest work, restored according to this inscription, seems to be as in Fig. 85.

It served to protect an isolated gate, which, being exposed on both sides, had to have both of them sheltered. Hence the sloping roof projects over both faces. All rests on the extremities of the two beams B; there is no framing, unless it is where the rafters meet at the summit and are halved together. Nothing is more logical, or even more primitive, than this arrangement, whose simplicity, none the less, is not lacking either in originality or in charm; in spite of its small dimensions, it has a certain monumental aspect that accords well with the severe and somewhat archaic forms of the architecture of the latest periods of the Roman republic.

The same characteristics are still more strongly shown in the framing of the temple which Vitruvius describes under the name of the Tuscan Temple (Liv. IV., chap. 7)[2].

On the columns were placed two like beams forming the architrave; these pieces, solid in themselves, were slightly separated, so that the air could circulate entirely around them. The pediment of the temple, which was sometimes made of wood, — no doubt because of the lightness of that material, — was not directly over the columns, but, carried on the extremities of four projecting beams, overhung by a distance equal to one fourth of the height of the columns; the rule given by Vitruvius on this point is perfectly clear, "(*Mutuli*) *quarta parte altitudinis columnæ promineant.*"

None the less, the aspect that we are thus led to give to the temple differs from that ordinarily attributed to such edifices; the overhanging pediment seems to fail to conform with the received principles of architecture, and ancient editors of Vitruvius, shocked by the prominence of the projecting beams, have thought to permute the first two letters of the word *AL*titudinis, and to write: "*Mutuli quarta prate LAtitudinis columnæ promineant.*" By this sacrifice they harmonize the ancient tradition with the present usages of architecture, but the correction is doubly at fault in being contrary to the text of the manuscripts, and in disagreeing with the ordinary forms of the language of Vitruvius. Vitruvius speaks of the diameter of a column in twenty places, and nowhere calls it "*latitudo*"; the only word he uses is "*crassitudo columnea.*" Our interpretation, moreover, is that admitted by the architects of

[1] This inscription is known as "*Lex puteolana parieti faciundo*" (Egger, "*Latini serm vetust reliquiæ*" p. 248; "*Corpus inscript. latin.,*" No. 577).

A graphic interpretation of the text was given by Piranesi (Tom. VI., plate 37), and an English translation is found in the work of Donaldson, entitled "A Collection of the Most Approved Example of Doorways" (London, 1836). The two interpretations agree, and I think them exact, at least as a whole. Nevertheless, as works received as authorities — and among them the "*Corpus inscriptionum latinarium*" — do not agree with this double commentary, I thought it would not be amiss to take the matter up again, limiting myself, be it understood, to the passages relating to the art of building. Moreover, it will be an occasion of rectifying the slight errors which seem to have escaped the English translator, and of putting more plainly in several places the idea concealed by negligence of orthography, and by forms of Latin that differ profoundly from those of the classic writers; I have profited in this revision by the explanations of one of the best authorities on the ancient Latin tongue, M. Egger.

". . . The place situated beyond the public road is separated from it by a wall; the contractor is to form a gate at the middle of this wall, which shall be seven feet high and six feet wide.

"Against the wall he shall place two antæ, MM., two feet wide and one foot thick.

"Above the opening he shall place a lintel of oak, A, eight feet long, one and one quarter foot thick, and three quarters of a foot high.

"On this lintel, and in line with the antea, he shall place in projection (*pro-icito*) two corbels of oak, B, two thirds of a foot thick, one foot high, projecting four feet beyond the wall on each side; and at the extremities of the corbels he shall nail painted doucines.

"On the corbels he shall place two small beams of fir, C, measuring one half of a foot on eace face, and shall fasten them with nails.

"He shall place rafters of sawed fir measuring one third of a foot on each face, spaced not more than three fourths of a foot apart, and carrying a sheathing of fir made of planks one foot wide.

"At the extremities of the rafters he shall fasten bandeaux of fir, E, three quarters of a

the Renaissance, whose taste does not seem to have been wounded by this unaccustomed projection. In order to convince one's self of this, it is only necessary to look at the drawing of the Tuscan Order and its accompanying notes in the original edition of Palladio (edition of Venice, Liv. I., p. 19).

Finally, there is left to us the sculptured imitations of ancient framing; the tombs of Lycia continually recall the forms of the wooden construction used by a people whose relationship with Etruria is well enough known. And everywhere in these sculptured copies of wooden temples we find overhanging pediments. The work of M. Texier on the ancient monuments of Asia Minor offers on every page proofs of this assertion. It is sufficient to cite what are perhaps the most remarkable examples, the tombs of Telmissus (pl. 176) and of Antiphellus (pl. 201). At Antiphellus, the projection of the pediment, as indicated by the figures given by M. Texier, is 0.950 m. to a height of 2.077 M.; this proportion is, I believe, the best possible commentary on the text of Vitruvius.

Let us admit the existence of these overhanging pediments as Tuscan temple seems equally advantageous, whether it is considered from the point of view of utility, or of the preservation of the monument.

This type of construction, in use at the time of Vitruvius, is related, as its name indicates, to the models of ancient Etruria; and it is doubtless not the only instance where the Romans followed the Etruscans in the matter of framing. Nowhere do the traditions of the art of building seem more persistent than in wooden constructions; and it would surely make this question itself clearer if the methods of the Etruscans were brought to light. We have the complete types of roofs in the carved imitations on the Etruscans' monuments; to cite the entire series would be to review the whole of the subterranean constructions of this remarkable people, so I have chosen but two, which seem to me to be the most remarkable of all on account of the clearness of the interpretation, and because of the judicious combinations which they show. Fig. 87 is one of the examples; it is the caissoned ceiling of one of the tombs cut in the tufa in the necropolis of Chiusi.

Here can be recognized, in proportions which the difference of

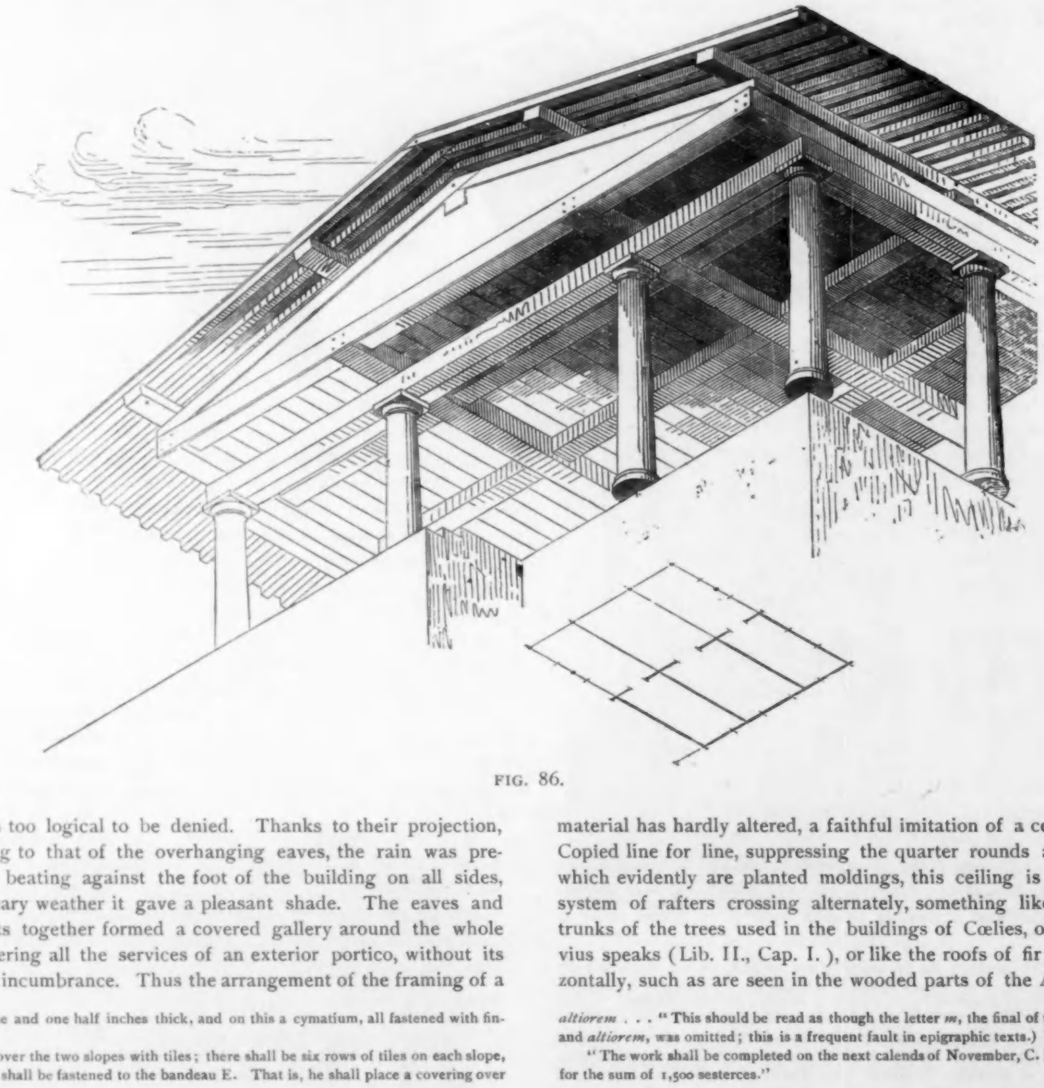


FIG. 86.

certain; it is too logical to be denied. Thanks to their projection, corresponding to that of the overhanging eaves, the rain was prevented from beating against the foot of the building on all sides, and in ordinary weather it gave a pleasant shade. The eaves and the pediments together formed a covered gallery around the whole temple, rendering all the services of an exterior portico, without its expense and incumbrance. Thus the arrangement of the framing of a material has hardly altered, a faithful imitation of a ceiling of wood. Copied line for line, suppressing the quarter rounds and the fillets, which evidently are planted moldings, this ceiling is reduced to a system of rafters crossing alternately, something like the roofs of trunks of the trees used in the buildings of Cœlies, of which Vitruvius speaks (Lib. II., Cap. I.), or like the roofs of fir trees laid horizontally, such as are seen in the wooded parts of the Alps.

foot wide and one and one half inches thick, and on this a cymatium, all fastened with finishing nails.

"He shall cover the two slopes with tiles; there shall be six rows of tiles on each slope, and the first row shall be fastened to the bandeau E. That is, he shall place a covering over the gate.

"The same contractor shall make and place, furnished with all ironwork and soaked in pitch, two gates of lattice with uprights of green oak, as in the gate near the Temple of Honor."

"For the mason work (*quod opus structile fiet*): —

"The earth (that is, the puzzolani) shall be mixed with one quarter of slaked lime.

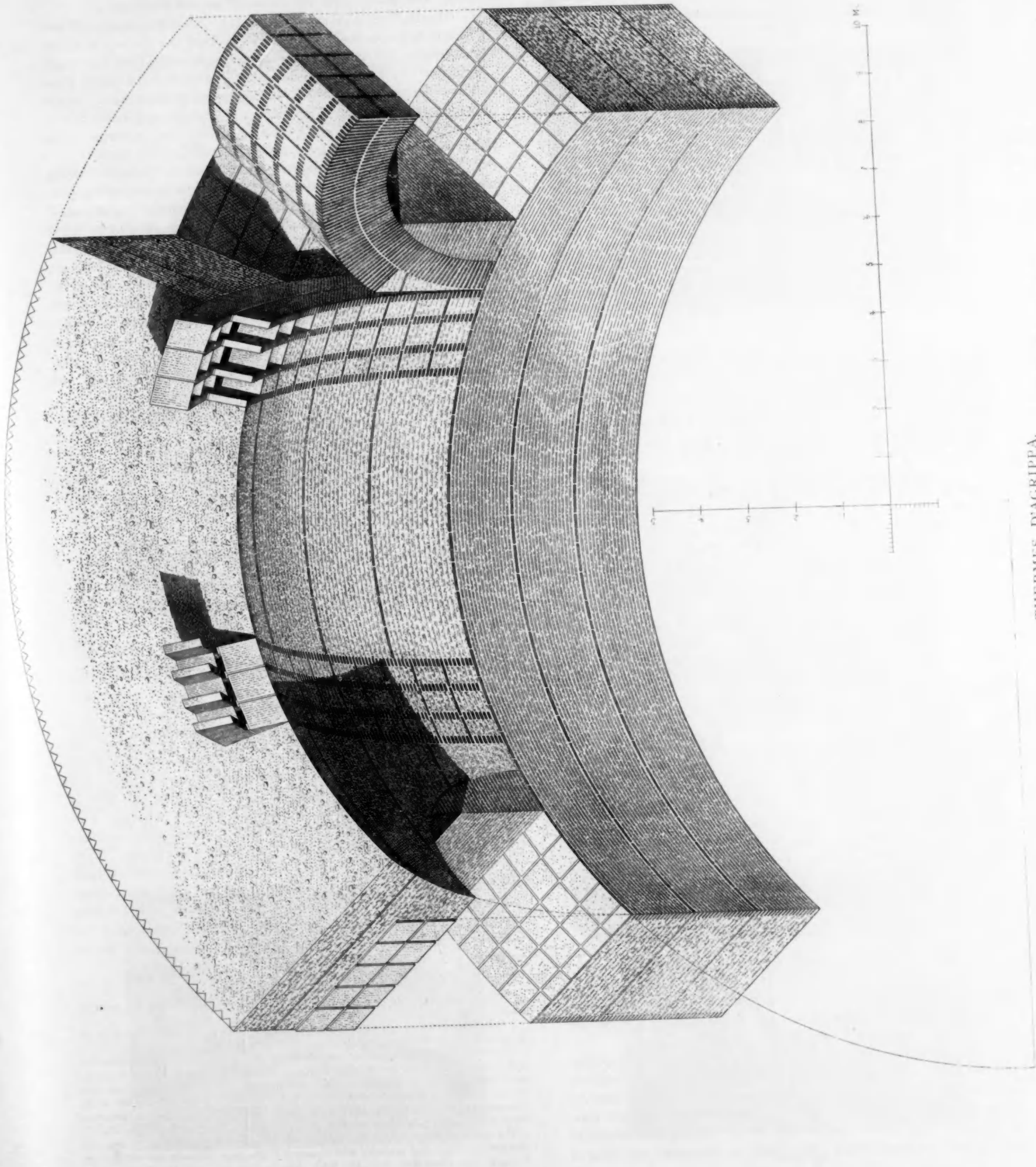
"He shall use for the rubble no stone that weighs dry (this is an allusion to the practise of wetting the stones before setting them) more than fifteen pounds, and shall use no cut stone more than four and one half inches high.

(Here the inscription runs "*Nive majorem cæmenta struito quam . . . nive angolaria altiorem* . . . "This should be read as though the letter *m*, the final of the words *majorem* and *altiorem*, was omitted; this is a frequent fault in epigraphic texts.)

"The work shall be completed on the next calends of November, C. Blossius contractor, for the sum of 1,500 sesterces."

[2] After having said in the clearest terms that a double beam (*trabes compactiles*) shall be placed on the columns as an architrave, separated by an interval of two fingers, in order to be safer from rotting, Vitruvius continues in these terms: —

"The corbels, placed on these beams parallel to the partition walls, shall project (*projicantur*) by a quantity equal to one quarter of the height of the columns. Their extremities shall be ornamented with bandeaux, and above these bandeaux shall be the pediment either of wood or of masonry. Finally, above the pediment, the roofing (*columen*), the rafters (*cantherii*), and the purlins (*templa*) shall be placed so as to give a projecting roof equal to one third of the roof itself."



THERMES D'AGRIPPA.

PLATE X. THE ART OF BUILDING AMONG THE ROMANS.

All the pieces are halved together; but nowhere are they appreciably weakened by their assemblage, for nowhere has the builder cut into a rafter near the middle of its span; if a rafter is cut into in assembling, it is always near its extremities, and thus the joining of the pieces is so arranged that the least possible amount is taken from their rigidity.

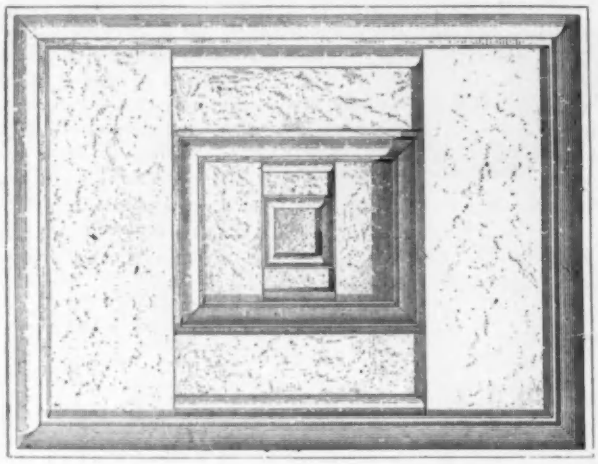


FIG. 87.

Another room of the same tomb has an imitation of woodwork whose forms are still nearer modern ones, but where the same spirit is manifested with a more perfect evidence. I give its general appearance in Fig. 88. Each of the caissons of which it is composed recalls that shown on the preceding figure (Fig. 87); there is the same care taken in the one as in the other to place the mortises near the ends of the pieces; there is the same general aspect and the same decorative effect. In both cases one sees at the same time the recollection of the framing itself and of the ornaments with which the ancients were accustomed to enrich it. The moldings were nailed into the reentrant angles after the framing was finished, a custom which seems to have been preserved by the Romans; for by a remarkable coincidence, it is precisely by means of such planted moldings that the *Lex puteolana* (see preceding foot-note) prescribes the decoration of the rafters and girts of the shelter: "The contractor shall nail a doucine on the bandeaux," and elsewhere; "at the extremities of the rafters the contractor shall fasten with nails painted doucines"; thus was expressed, a hundred years before our era, the contract of Pozzuoli; and such was the Etrurian framing contemporary with the tombs of Chiusi.

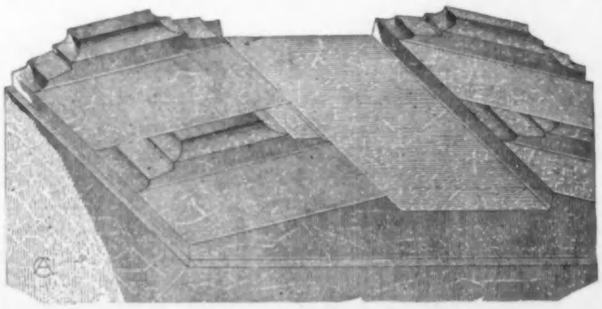


FIG. 88.

The rafters, as shown in the last figure, are very close together, and the intermediate pieces make the space so small that it could be spanned by tiles, or better, as is still practised in the same country, by an intermediary paving of bricks between the rafters and the tiles, of the roof. The bottom face of the bricks forming the bottom of the caissons remained visible; they could be decorated with enamel or paint, and the rafters, covered with the violent colors that the Etruscans knew how to harmonize so well, gave to the composition a richness full of elegance.[1]

Here is a last detail of Etruscan framing, brought down to us through Vitruvius. It was a question of covering the portico or cloister which surrounded the atrium of ancient dwellings.[2]

"In the Tuscan *cavædium*," he says, "horizontal pieces, AB and CD, resting on the walls of the court, support the transverse rafters (*interpensiva*) EF and GH; the corner rafters run from the angles of the court to the angles of the main beams, and the rafters slope towards the central basin." This description permits us to restore the roof, as in Fig. 89. The solution is evidently applicable only to a court of small size, in which case it permits the sheltering of the sides without encumbering the passages by isolated supports.

If now we examine together the Roman or Etruscan framing shown in the last five figures (85 to 89) from the same point of view, we will perceive in the diverse combinations a common physiognomy, a family likeness, as it were. Those large pent-houses, as we might call them, the projecting roofs of the Etruscan temples that overhang by an amount equal to one third of the height of the columns, the shelter at Pozzuoli that projects beyond the wall by a half of the height of the door that is protected by it, the care taken for the preservation of the timber, either by separating the doubled beams or by keeping the mortises near the extremities; all these things seem scattered details, too insufficient to allow us to restore the complete picture of the art of framing among the ancients; but they at least indicate its spirit and its tendencies. The great projection of the roofs was logical under a burning sky, and their slight slope seemed appropriate to a country where snow was rare; but the Romans, I believe, committed the error of applying this form of roof to our Northern countries, for which it was not suitable. This was one of the rare instances where they extended their methods with their power, without regard for the variation in climate. They covered the unvaulted halls of the Baths of Paris as they would have covered a temple or a basilica at Naples,[3] and this unfortunate example was imitated in the architecture of the Northern provinces long after the fall of the Roman Empire; its influence lasted until the middle of the twelfth century, and is still felt in our day. But let us go back to the Roman constructions.

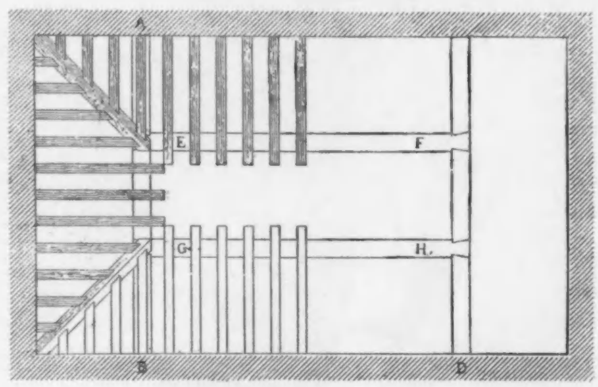


FIG. 89.

(*To be continued.*)

[1] In Figs. 87 and 88 the backgrounds were white, the beams red, and the moldings black.

[2] The restoration in Fig. 89 corresponds exactly with the one given by Mazois in his work on the ruins of Pompeii (Part II., plate 3).

[3] It must be recognized, however, that this custom, though everywhere the dominant one, was not entirely exclusive. The ancients, besides the tiles with long run whose fragments are to be seen in all our museums, used flat slabs, laid to lap, which exacted a slope much less pronounced. We have a sculptured imitation of them in the conical roof of the Mausoleum of St. Remi; it is apparently this kind of roofing that Pliny refers to, designates under the name of "*pavonaceum tegendi genus.*" (*Hist. Nat.*, Lib. XXXVI., Cap. XLIV.) — The roofing of shingles (*scindulæ*) was, morever, much used by the ancients. It was used principally in Gaul, and evidently with it steeper slopes were necessary than those of the Romans. (See Plin., *Hist. Nat.*, Lib. XVI., Cap. X.; Cf. Vitr., Lib. II., Cap. I.).

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

BY GEO. HILL, C. E. (*Concluded.*)

CLAY ARCH TESTS.

Test No 96.— This was of a 12 in. end-construction hard tile arch, similar to the preceding, eccentrically loaded, the center of the load being placed 18 ins. from the center of the web of one skew-back beam. When the load was placed on this arch the voussoirs at the left-hand side under the point of application of the load slipped past the key block, fracturing and splintering it. Increased pumping resulted in no increase in the pressure. The maximum load was 3,800 lbs. After it was found that no gain in pressure could be made and that the plunger had gone almost the full length of its travel, the load was discontinued and many of the voussoir blocks were found to be intact except for splintering on the edges. Arch after failure shown in Fig. 51.

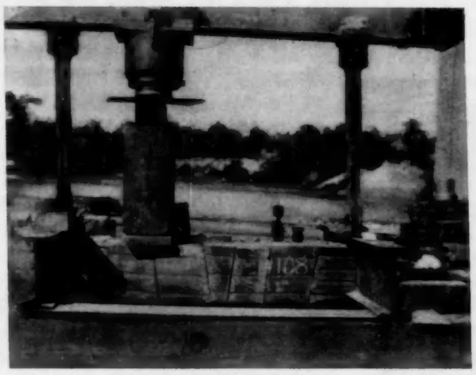


FIG. 51.

Test No. 97. — This arch was of the 8 in. side-construction hard tile plain skew-back type. It was loaded eccentrically with the center of gravity of the load placed 18 ins. to the right from the left skew-back beam, and failure occurred by the shearing of the top web at the left-hand edge of the load block, as is shown in Fig. 52. The maximum load of 1,500 lbs. was reached in 1.2 minutes.

Test No. 98. — This arch was similar to No. 97, but centrally loaded. Failure occurred by the collapse of the voussoir next to the key at the left-hand end, or under the edge of the point of application of the load. The balance of the arch remained intact. The maximum load of 2,500 lbs. was reached in 2.7 minutes.

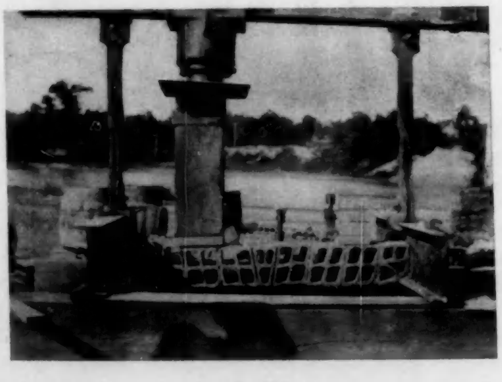


FIG. 52.

Test No. 99. — This was made on an arch two courses wide, of blocks similar to those of Nos. 97 and 98, with about 1½ ins. of sand covering them; the bearing blocks were 18 ins. wide, 4 ft. 4 ins. long; the lower edge of one skew-back broke off at 9,950 lbs. Continued pumping resulted in a decrease in the pressure to 2,500 lbs., and then the second course tumbled in. Fig. 53 shows how the left-hand skew-back failed by shearing down at the point of junction of the curved rib with the vertical and horizontal portions. This skew was the only part of the course that was injured, which can be seen in the illustration.

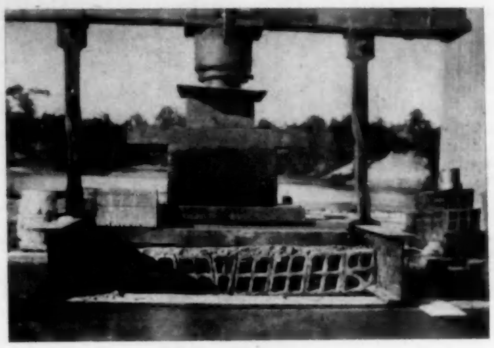


FIG. 53.

Test No. 100. — This was similar to No. 99 in all particulars; the loading was on a plank 10 ins. wide and 2 ft. long, centrally applied. At 2,000 lbs. the bottom began to open and there was a little crushing at the crown; at 2,500 lbs., reached in 3.4 minutes, the

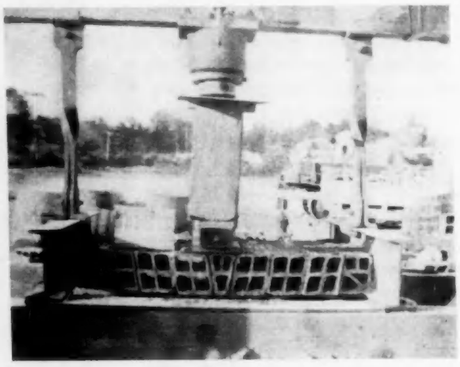


FIG. 54.

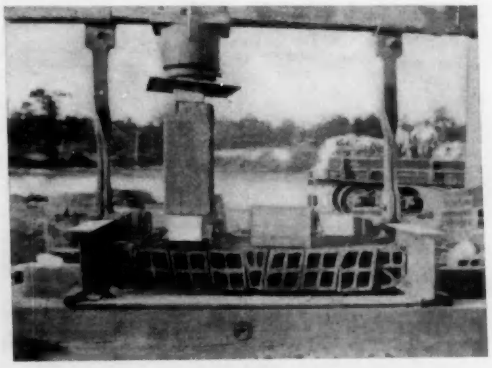


FIG. 55.

voussoirs next to the point of application of the load to the right and the one north of it both crushed in, letting down both courses (Fig. 54).

Test No. 101. — This test was made on two courses arranged as

FIG. 56.

in Test 100, and eccentrically loaded. At 1,250 lbs. one of the voussoirs east of the west skew-back cracked through on the edge near the top. At 2,000 lbs. it was cracking off in slivers. When failure occurred, the top voussoir collapsed just to the right of the left skew-back. The voussoir immediately under the load also fell in at the point of fracture. The maximum pressure was 2,750 lbs., reached in 2.5 minutes (Fig. 55).

FIG. 57.

The final series of tests were made recently at the Ireland Building, of commercially constructed fire-proof arches under various forms of loading and points of application thereof. The arches were in all cases 8 in. side construction, hard tile protection skews of 50 in. span. The form of loading employed is shown in Fig. 29a for concentrated load, whether centrally or eccentrically applied, Fig. 61 for a distributed load.

The method of cribbing shown consisted in using 3 in. by 4 in. yellow pine sticks, 1 in. apart in the clear, decreasing in length and giving a true condition of uniform loading. This was demonstrated by series of levels taken throughout an entire test, showing that the arch curved uniformly over its span. The only peculiarities in the form of failure are shown as follows: —

FIG. 59.

Fig. 56 is a vertical upward view showing the block broken under point of application of the load of Test 101.

Fig. 57 shows the way in which the blocks failed under the point of application of the load, Test 104; the view being from above, and showing the side of one of the voussoirs adhering to its neighbor, and another one of the voussoirs broken.

Fig. 59 shows the ceiling under the point of application of the load of Test 110.

Fig. 60 shows the diagonal breaking of the ceiling under the load of Test 112.

Fig. 58 is a view of the under side of one of the arches, which had been cut out so as to limit the length.

The results of these tests are given in Table 5 hereto appended, and will well repay study.

CONCLUSION.

Any one who is willing to analyze all of the tests made must be struck, first of all, with the very great differences shown in the ultimate resistance of the arches following all the way from practically a few pounds per square foot upwards to several thousand pounds.

This apparent discrepancy is due to the following causes: —

FIG. 58.

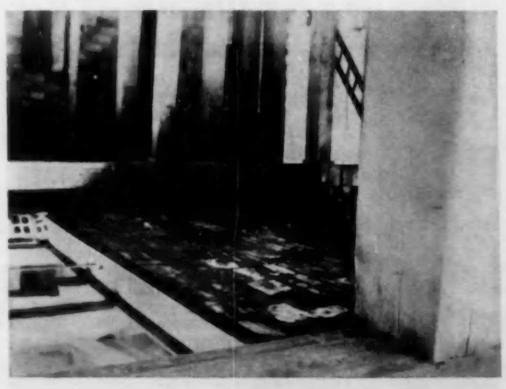


FIG. 60.

TABLE No. 5.

Test Number.	Width. Inches.	Total Arch Area. Square Feet.	Loaded Arch Area. Square Feet.	Total Load. Pounds.	Load per Square Foot of Arch.	Load per Square Foot Loaded.	Horizontal Thrust.	Shear per Foot Skew.	Character of Loading.	Deflection. Feet.	
102	264	9.0±	0.73	97.50	....	13.350	12.150	....	Central..........	....	Whole length of section cracked, west end of bay.
103	264	9.0±	0.73	18.500	....	25.360	25.150	....	Central..........	....	Near center of bay, sheared down, One bay.
104	264	9.0±	0.73	11.900	....	16.300	14.890	....	Central..........	0.039	East end of bay, loaded block crushed,
105	264	9.0±	0.73	10.000	....	13.700	12.500	....	Central..........	0.025	East end of bay, north of 104,
106	264	9.0±	0.73	13.500	....	18.500	16.880	....	Central..........	0.083	Middle of bay, north of 103, One bay.
107	264	9.0±	0.73	14.500	....	19.860	18.130	....	Central..........	0.12	West end of bay, north of 102,
108	54	18.72	0.73	9.000	481	12.330	11.250	1000	Central..........	0.08	North of 107, cut section.
109	48	16.64	0.73	10.000	602	13.700	12.500	1250	Central..........	0.036	North of 106, and east of 108, cut section.
110	48	16.64	0.73	6.000	361	8.225	7.500	750	Central..........	0.078	North of 105, and east of 109, cut section.
111	264	9.0±	10.55	20.000	....	18.95	50.000	....	Distributed.......	0.034	
112	264	9.0±	10.55	25.000	....	23.66	62.500	....	Distributed.......	0.051	South of 111, affected section 6 inches long.
113	54	18.72	9.75	11.500	614	11.80	28.750	1280	Distributed.......	0.115	Cut section, open bay, south side, skew sheared.
114	48	16.64	10.28	17.000	1020	16.55	42.500	2126	Distributed.......	0.068	North of 113, cut section, forced down on center.
115	48	16.64	10.28	12.500	752	12.15	31.250	1565	Distributed.......	0.038	West of 114, cut section, forced down on center.
116	48	16.64	10.28	15.500	933	15.10	38.750	1940	Distributed.......	0.065	South of 115, cut section, skew failed, deflection showed true curve to bottom.
117	264	9.0±	10.28	22 500	....	21.90	56.200	....	Distributed.......	0.16±	Skew sheared next open bay.
118	264	9.0±	10.	15 000	....	15.00	37.500	....	Distributed.......	0.018	South of 117, west of 111.
119	264	9.0±	0.73	8.000	....	10.900	10.000	....	Central..........	0.026	West of 118, cinders removed.
120	264	9.0±	9.75	17.500	....	18.00	43.800	....	Distributed.......	....	West of 118, cinders removed.
121	48	16.64	10.28	9.500	570	9.25	23.775	1188	Distributed.......	0.08	West of 118, cinders removed at skew sheared.
122	48	16.64	0.73	4.100	216	5.620	5.130	513	Central..........	0 33	West of 118, cinders removed at skew sheared on under side.

(*a*) Defective design, which the manufacturers of tile arches have by experience outgrown some years since.

(*b*) Tests of individual blocks without cement joints to determine the strength of the block alone, the need for cushioning, or the effect of distribution, the tests being of a laboratory nature and intended to assist the designer of blocks rather than the user.

(*c*) The difference in the character of the mortar, age, and width of block intended as a guide for the use of blocks in particular locations, or to indicate the length of time that the centers should be left in position.

A further study will demonstrate the following results: —

First. Considered purely as a matter of strength, hard tile is stronger than porous terra-cotta.

Second. Considered as a question of resistance to shock, porous terra-cotta is stronger than hard tile.

Third. The protection skew of a side-construction arch, as they are often constructed, is always a source of weakness, causing failure at the skew-back, as shown by Fig. 40. The proper form is that shown in Fig. 38; in other words, the lower member, which is the one that transmits the thrust of the arch to the skew-back, must come well within the supporting surface of the skew-back, and must also be thoroughly backed up, as otherwise the thrust will rupture the skew-back block.

Fourth. In arches of the same span the strength varies as the square of the depth.

Fifth. In arches of the same depth, the strength varies directly as the length.

Sixth. Where the ratio of depth to length approaches one to eight, the skew-back beams at the beginning and end of all tiers must be tie-rodded very thoroughly, as they will otherwise cause the failure of the arch by the kicking out of the skew-back.

Seventh. The thrust from an arch can be directly calculated from the formula usually accepted, the rise being taken at 1¼ ins. less than the distance from the bottom flange of the skew-back beam to the top of the arch.

Eighth. Commercial arches have their strength very much increased by a cinder filling, even though the filling may not be of good concrete.

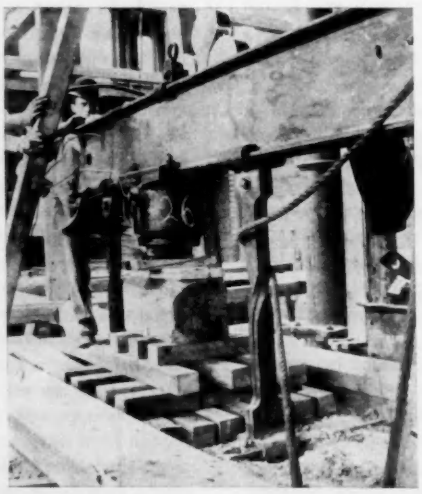


FIG. 61.

Ninth. Commercially, it is cheaper to employ an arch of the full depth of the skew-back beam than to fill the voids between the top of the arch and the top of the beam with cement.

Tenth. A stronger arch is secured by using the deep block than by using a shallow one, and the load on the floor is decreased.

Eleventh. For all conditions of use of floor arches where the anticipated loads are under 150 lbs per square foot total dead and live, either end or side construction, arches may be used, and the character of mortar required is not of importance. For loads exceeding 150 lbs. per square foot, end-construction arches should always be employed, and, as the loads increase, the character of the mortar should improve until at about 400 lbs. per square foot the very best Portland cement mortar should be employed.

Twelfth. The greatest strength is attained with the least material when the arch blocks are formed with simple rectangular cells of the usual form.

Thirteenth. Specifications which require a certain ultimate strength of block must designate exactly the conditions under which the tests will be made, specifying composition of mortar, length of span, area of arch to be tested, number of arches to be tested, and every other detail, since the absolute resistance of 1 sq. ft. of an arch is greater when 100 sq. ft. are around it than when there are but 5 sq. ft.

Fourteenth. Some form of testing apparatus similar to that employed by the author must be employed for anything like satisfactory results.

Fifteenth. It is desirable that all tests made should be recorded and as many made as possible, in order to have a greater number of tests on which to base conclusions. It may be that with more extended series, similar in character to those given in Table 5, we can devise a form of arch and especially a form of joint for end-construction arches which will be more economical of mortar, quicker to erect, and, therefore, will give more uniform results. The weak point in the end-construction arch at the present time is that it requires an excess of mortar, and usually results in a concentration of the load on points of the clay which start failure. The burning of the clay inevitably warps it, and thus makes it difficult or practically impossible to employ any form of socket brick to make the joint with. But for commercial purposes the strength of the usual forms is ample.

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

EARLY in the present century, several mechanical contrivances were introduced, designed for the purpose of measuring the values of cements.

Conclusions were sought to be reached by subjecting samples of cement, mortar, and concrete to various tests, among which may be named the needle or penetration test, the transverse, adhesive, compressive, torsional, and tensile strain tests, and in later years came the boiling and freezing tests.

The needle test, invented by M. Vicat, was perhaps one of the earliest, if not the earliest, method employed.

General Totten employed the needle test at Fort Adams, Newport, R. I., for several years prior to 1830, and soon thereafter employed the transverse test.

It may be stated that the needle test was practised to determine the time in setting, and the relative hardness attained at stated intervals during the process of hardening of the cement samples.

As this test did not indicate the ultimate strength of a cement, or a cement mortar, it soon gave place to the transverse and the adhesive tests.

General Gillmore employed the needle, the transverse, the tensile, and the adhesive tests prior to 1860.

Briefly, these tests may be described as follows:—

The relative hardness of the samples at stated intervals during and after the process of setting was measured by the penetration of a steel point or needle impelled by the impact of a falling body.

The transverse test consisted in the molding of cement or cement mortar into prisons or bars usually 2 ins. by 2 ins. by 8 ins., under pressure, which, after setting, were placed in water, and after a specified number of days had elapsed were broken by being placed on supports 4 ins. apart, and a pressure brought to bear midway between the supports.

The adhesive properties of a cement were measured by cementing bricks and blocks of stone together in pairs under pressure during the time of setting, and afterwards drawing them apart by a force applied at right angles to the plane of the joint.

The tensile test was practically the same as that now in vogue; the form of the briquettes, and the machines for conducting the tests named, have changed considerably, but the principles involved are practically unaltered.

The transverse and compressive tests are still occasionally resorted to, but the torsional and adhesive tests are no longer practised to any extent.

Between 1850 and 1860, the mode of testing cements by means of the tensile-strain testing machines gained largely in public favor in France, and was soon followed by a like tendency in England.

It was adopted by the Metropolitan Board of Works in London in 1859, and under the supervision of Engineers Grant, Bazalgette, Colson, Mann, and others soon became considered as a valuable adjunct in the determination of the qualities of the various cements offered on that work.

From that time until the present, the tensile-strain method of testing cements has constantly grown in public favor, and has become the universal practise among engineers, architects, and manufacturers.

Why this mode of testing the strength of cements and cement mortars survived almost to the exclusion of the others, it is hard to determine.

It certainly cannot compare with the transverse test for simplicity of machinery or accuracy of results.

In the formation of the samples to be tested for the transverse tests, the prisms, being straight, uniform bodies, could be readily subjected to any predetermined pressure, and the density of the prisms be gaged to a degree of uniformity unattainable in the modern briquette.

Cement testing, although practised now much more than formerly, is still far from being reduced to any fixed system of rules.

Each engineer or architect is a law unto himself, and United States engineers even do not seem to be governed by any one standard, and it would be difficult to find a brand of cement which could fulfil all the requirements of the various specifications which are from time to time given out to the manufacturers.

Thus, for example, one set of specifications states that "the cement must be freshly burned," but, "must not take less than twenty-five minutes to bear the light wire, that is, a weight of four ounces on a wire one twelfth of an inch in diameter."

Now nearly all of our best brands of rock cements will bear the light wire in about one half of the time specified, if tested when fresh, but will fulfil the requirements if they have had time to season.

Much also depends on the amount of water used, as the initial set can be retarded by a trifling addition of water, or hastened by using just enough to enable the cement to be molded.

But in this, as in many other matters connected with the testing of a cement, the manufacturer has nothing to say. He is at the mercy of the engineer, and engineers who are willing to accept suggestions from the manufacturers are not as thick as autumn leaves in Vallombrosa.

It is certain that all the best brands of rock cements in this country are improved by one or two months of seasoning, and all this that we read about, to the effect that rock cements must be used immediately after manufacture, lest deterioration may set in, is arrant nonsense.

The author is familiar with every brand of rock cement produced in this country, and he does not know of one brand that is not improved by one to two months' exposure.

The manufacturers understand this, for, to learn the value of seasoning, they have but to set aside a tightly closed package filled fresh from the mill spout, and take some from the same grinding and spread it in a dry place where the air has free access to it, and at the end of thirty or sixty days test both samples.

And yet they are daily confronted with specifications stipulating that the cement must be freshly burned.

Some of the very best brands of rock cements in this country are vastly improved by four months' exposure, if kept on floors high enough from the ground to preclude the possibility of the absorption of moisture from below.

A rock cement which is not improved by an exposure of from thirty to sixty days can hardly be considered a strictly first-class cement.

There are several of our best brands of rock cements that are naturally moderate in setting when given even a brief exposure, yet when tested fresh, will take a rapid surface hardening and give every appearance of being naturally quick setting; but an examination of the fracture of briquettes made from such cements will disclose the fact that at twenty-four hours crystallization has barely commenced, thus giving evidence of not too rapid setting. Still the superficial hardening, due to freshness, will cause them to bear the light wire too soon to bring them within the specifications.

In this way it oftentimes happens that a really first-class cement may be rejected because it sustains the light wire too soon.

The author has seen a fresh cement rejected because it bore the wire too soon, and the sample set aside, and after a few days had elapsed, tested again from mere curiosity, and found to be slow enough to come within the specifications.

During the few days of exposure the peculiarity noted had entirely disappeared.

(*To be continued.*)

EDITORS BRICKBUILDER:

In the June number of your most excellent journal, I note in the "Mortars and Concrete Department" an article signed by Spencer B. Newberry, in which it is stated, "The same result will doubtless be reached here as has been reached in Germany; namely, the complete replacement of the common natural-rock cements by artificial Portland."

This opinion has from time to time been expressed by different writers, all of whom are, or have been, engaged in the manufacture of Portland cement.

While the statement is practically true as to the cement industry in Germany, yet it is so for the very good reason that there are no really first-class cement rock deposits in that country, and not one in all Europe that can compare with the many wonderful cement rock formations in this country.

In the cement department of "Mineral Resources of the United States" for 1894, on page 581, we find the following passage, written by Spencer B. Newberry:—

"The battle between natural-rock and Portland cements has been fought out in England and Germany, and has resulted in the complete victory of Portland, and the practical disappearance of the natural-rock cement industry. The result in this country can hardly be so decisive, as most of the natural-rock cements produced here are certainly greatly superior to the Roman cements formerly made in Europe."

Although this last quotation from the pen of Mr. Newberry was written a year or more earlier than the first one, it is considerably more quieting and soothing to the nerves of an ordinary rock-cement manufacturer, for in this quotation he admits that most of the rock cements here are greatly superior to those of Europe, and that the battle in this country can hardly be so decisive in favor of the Portlands.

I am not given to writing letters for the press, and am not accustomed to it, but in this instance I feel moved to contribute a few thoughts to THE BRICKBUILDER, a journal I have carefully read since its first issue.

I have been engaged in a modest way in the manufacture of rock cement for many years, and what little I have in worldly goods is employed in that industry. Consequently I am deeply interested in all literature pertaining to that subject.

I have no desire or intention to enter into any discussion, much less a controversy, with the authors of the gloomy prophecies alluded to, but, as this is my first, and in all probability may be my last letter to you, I trust I may not trespass too much on your valuable space if I submit a few propositions.

1st. Would it not be more in keeping with the eternal fitness of things if some of the Portland prophets should now and then offer some evidence in proof of their assertions concerning the final disappearance of rock cements from this country?

2d. Taking "Mineral Resources of the United States" as authority on cement statistics, it appears that the rock cement output for 1880 amounted in round numbers to 2 millions of barrels; and in 1894 it had grown to the quite respectable sum of 7½ millions of barrels. During this time the total output exceeded 81⅓ millions of barrels; and without having the returns for 1895, it is fair to assume that the total output from 1880 to 1895 inclusive will crowd very closely on 90 millions of barrels.

3d. With the production of rock cement amounting to 7¾ millions of barrels, and that of the artificial product being less than 1 million barrels yearly in this country at the present time, is it not quite amusing to read the assertions by the Portland prophets that "the battle is on"?

4th. I want to enter a mild protest against the Portland prophets calling rock cement "common." It is no more common than is Portland, and the term should be resented by all manufacturers of rock cements.

Mr. Cummings, in his exhaustive papers to THE BRICKBUILDER on "American Cements," uses the term "rock cement," and occasionally "natural-rock cement," but as yet he has not called rock cement "common."

It is a name given it by the artificial cement makers, presumably for the purpose of conveying the idea that their own cements are uncommon.

So long as the Portland people persist in designating rock cements "common cements," the rock-cement people should speak of the Portlands as "mud cements," and not be outdone in the matter of courtesy by the gentlemen who only produce one barrel of cement out of every nine made in this country.

5th. In 1880 the rock-cement properties in this country were worth at a fair valuation $3,000,000. To-day, at a fair valuation, these properties are worth $9,000,000.

6th. Finally, I submit that if during the past sixteen years the output of rock cement has increased nearly fourfold, and the valuations threefold, would it be asking too much of the Portland prophets to kindly fix the date when the rock cements are to finally disappear from the American markets, and thus give our "common" cement makers a reasonable warning to stand from under.

A WESTERN ROCK-CEMENT MAKER.

THE STRENGTH OF COMMON MORTAR.

HERR BESCHETZNICK, an Hungarian expert, has been investigating common mortars, feeling that too much attention had been devoted to the higher cements by scientific men in all countries. He tried various kinds of lime, and slaked them all under the same conditions, afterwards allowing them to mature for a week. Mixtures of lime thus treated and ordinary building sand with water were then prepared, and tested after they had been allowed to set for one, three, and twelve months.

The result of the tests showed that poor limes set more quickly than fat limes, but that the strength of the latter was relatively greater when the mixtures used were poor in lime. Thus, 1 : 5 mixtures of fat lime had nearly the same strength as 1 : 4 mixtures of poor lime.

An American, A. S. Cooper, has also been investigating the question of mortars, turning his attention to the influence of the character of the sand upon them. He used sands of varying fineness and character of grain, and after numerous experiments arrived at the following conclusions, namely:—

1. Other things being equal, a fairly coarse sand, for example, one passing through a 12 in. sieve (12 wires to the mesh), and caught on a 16 in. sieve, gives mortars of higher tensile strength than do finer sands.

2. This effects of size of grain disappears with sands fine enough to pass a 40 mesh sieve and caught in a 60 mesh sieve. Sands finer than this give similar results.

3. The character of the surface of the grains is of moment. Mere sharpness of grain is not the only point to be considered, for an extremely sharp sand may have a smooth surface on each facet, and a moderately rough surface is preferable.

All the above results, namely, those of Beschetznick and of Cooper, are of direct practical value, and should be made use of by those who have to use mortar, and are desirous of employing only a thoroughly trustworthy mortar, which will stand the test of time.

It is certainly high time that the composition of the various cementitious materials used in building should be defined, and that the strengths of such materials of known composition should be ascertained, so that nothing should be left to mere chance, or to the intelligent discretion of those talented assistants to whom we alluded in our opening paragraph.—*British Brickbuilder.*

The Masons' Department.

Conducted in the Interests of the Mason and the Contractor for Brickwork.

THE ARCHITECT AND CONTRACTOR.

BY THOMAS A. FOX. (*Continued.*)

METHODS OF ESTIMATING.

WITHIN the past few years much has been done to improve the various systems under which the construction of buildings are carried on, and the proper relations which should exist between owner, architect, and contractor are constantly being more clearly defined and generally recognized; but so long as we are handicapped by the present method of estimating, there is bound to be friction between the various parties to a building contract. Even in much of the largest and most important work, the means by which the contractor determines the price at which he is willing to undertake the contract is a development of the methods still employed in many of our country towns, where the builder casually looks over the drawings and then "guesses" the building will cost so much. Often the guess is too high, often too low, sometimes about right, and the builder carries on his work in the faith that in the long run these differences will average themselves, and the net result will show a balance in his favor. For a proof that such is the fact, one has only to recall the familiar and stereotyped remark of a contractor who has figured a piece of work too low, "Never mind, I'll make it up somewhere else," which clearly shows that in many if not a majority of cases he does not know, until it is finished and paid for, whether a certain piece of work represents financially a profit or a loss. The method of obtaining estimates which is generally followed in this country is, for the architect to prepare drawings and specifications, the former generally consisting of floor plans, elevations, sometimes one or two sections at the scale of one quarter of an inch to a foot, and rarely details to a larger scale. With these before him, the contractor proceeds to estimate the price at which he is willing to undertake the work, and the first step is to ascertain the value of the materials called for, which is done by taking off the quantities, that is to say, determining the number of cubic yards of excavation, perches of stone in the foundation, number of bricks in the walls, pounds of iron, or feet of lumber in the frame, and so on through the various items which go to make up the construction, finish, and decoration of the entire building, or at least such part of it as the contractor is to figure on, and placing on each its proper value. Now if the drawings and specifications are complete and accurate, that is to say, if the quality, workmanship, etc., of various items are described in the specifications, and the quantity of each is shown in the drawings, then it is a simple matter for any intelligent contractor to estimate with considerable accuracy the value of the different materials themselves which will be required.

But here at the outset, and on the only part of the work which can give definite results, the contractor is often handicapped by having drawings and specifications which are insufficient to enable him to form an intelligent estimate of the quantities, and the architect usually seeks to remedy this defect by "blanket clauses" and "general conditions," which add to the already existing element of uncertainty. There are many reasons why architects are often forced to present drawings for estimating which are more or less incomplete, the principal one, of course, being the short time allowed for their preparation; but the architect should not be hurried at the expense of the contractor; such loss should be put on the owner who demands it, and the architect should insist on time to complete his work properly. The great trouble comes from owners insisting on knowing the cost prematurely and at another's risk. And although competition is such that contractors seldom refuse to estimate on an incomplete set of drawings, they are, nevertheless, sure to lay an anchor to windward, and provide for contingencies in ways which are sure to prove embarrassing to both owner and architect at later stages of the work.

After figuring the value of the materials, comes, secondly, the question as to the amount of labor involved, and it needs no demonstration to prove that value of this item is much more variable and indefinite than that of materials. The ability to place a proper estimate on labor comes only after experience and careful observation on the part of the contractor, which should be supplemented (although it rarely is) by comparisons derived from a set of books, which should be so kept as to show at a glance the profit or loss of each piece of work as soon as it has been finished and paid for. The item of labor, which is at best indefinite and liable to wide variation, has been made more indeterminate of late by the restrictions and limitations which have been placed upon it by the labor unions, the most conspicuous of which is the maintaining of a uniform rate of wages without regard to a man's individual ability. Another element of uncertainty has also been added from the necessity of carrying on building operations during the winter months, when the amount of work performed is largely dependent upon the conditions of the weather.

Third. The contractor must make due allowance for contingencies, wear and tear of plant, accidents, strikes, and last, but by no means least, for the vagaries and peculiarities of the architect and his superintendent, and the risks he, the contractor, runs under existing conditions of being called upon to perform work under blanket clauses and general conditions for which no definite allowance was made in the estimate, and which are, of course, unknown quantities.

Fourth. The contractor must include the profit he desires to realize over and above the cost of the labor and materials and allowances for contingencies, etc.

It can be seen from this brief analysis of the conditions under which estimates are obtained, that under most favorable circumstances there is a large element of uncertainty. And, therefore, under the normal or usual conditions existing to-day, the uncertainty practically dominates, and the estimate is consequently simply an intelligent guess.

Now it is a self-evident fact that no contractor will undertake work which in the end will not yield a fair profit, and the greater the element of uncertainty which exists, the larger will be the margin of profit, a parallel case being that of insurance where the greater the risk the larger the premium. It is the owner who pays in the end for this uncertainty, and as the reputation of the architect is in a large measure dependent upon his standing with his clients, it is manifestly for his advantage to do all in his power to reform the methods of estimating, so as to reduce to the minimum this element of uncertainty, and thereby be enabled to bring the cost of his buildings to the lowest point consistent with good construction and thorough work.

It must not be taken for granted that because, when estimates are received on a given piece of work, and it appears that the cost is within reasonable limits, that the profit of the contractor has necessarily been included; for it has already been pointed out in a previous paper that it is a well-known fact that many contractors figure work at cost or even below, and depend for their profit on the "extras" which they are morally sure will be required before the work is finished. An example of this can be seen in the case of a contractor who figured for years in the office of a well-known firm of architects without getting a single piece of work, and although his competitors were far below him in price, they claimed to make a good profit on their contracts. At last he determined to find out the secret of their success, and figured the next time to do the work at much less than cost. This time he was successful in obtaining the contract, and as the work progressed he soon found that by means of "extras" he was able not only to make up the deficit, but in the end to realize a satisfactory profit.

This is but a single illustration of one of the most radical defects of our present methods of estimating. For the contractor should be paid for "extras" at the same rate as for similar work included in the contract, but under existing conditions it is practically impossible to regulate this abuse without wranglings, delays, and lawsuits, which cost in the end as much, if not more, than the payment of the contractor's unjust demands.

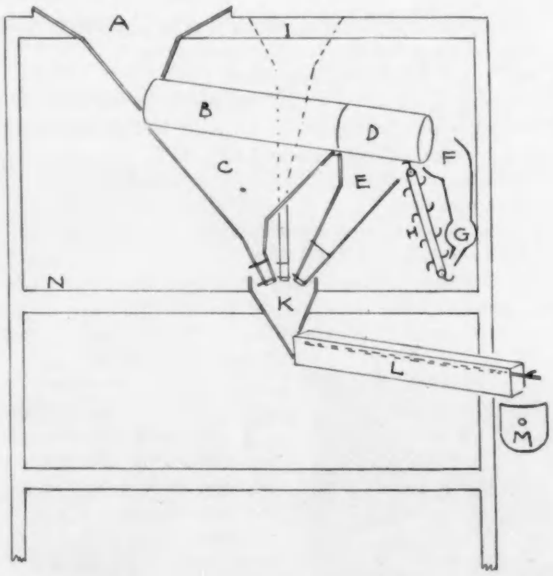
The fault lies in the system which has grown without regulation or restriction from the time, not much more than fifty years ago, when the architect and builder were one and the same person.

(*To be continued.*)

CONCRETE MIXING MACHINE USED IN CONSTRUCTION OF BOSTON SUBWAY.

THE machinery for sifting sand and mechanically mixing and delivering concrete which is used on the third section of the subway was designed by the contractors, Messrs. Everson & Co. It is not especially new in principle, but is combined in a very effective way and operates very successfully. The accompanying sketch diagram will illustrate the idea of the machinery, though it does not in any sense illustrate the actual construction. It will, however, serve to make clear the process by which the various materials are mixed and converted into concrete.

The earth which is excavated from the subway at this section of the work is composed almost entirely of clean, sharp sand, with a great deal of gravel and some loose stones scattered through it.



All the material is suitable for use in concrete. The mixer is housed in a strong wooden structure some 30 ft. square, which is strongly braced, and rests upon a track which is extended as necessary, so that the structure closely follows the group of derricks and hoisting machinery used to assist in excavating the soil. The earth as excavated is hoisted by the derricks to the top of the mixing house and dumped into a large hopper at A. Thence it descends into a long cylinder, BD, the first portion of which is covered with a fine wire netting. The cylinder is in constant rotation, and the sand is sifted out, falling into the hopper C, while the stone and gravel are carried along by the rotation of the cylinder to the portion marked D, which is cased with a netting of a coarse mesh, sufficient to allow the gravel to fall through into hopper E, while the stones are carried along and dropped out at the end of the cylinder into the hopper F, which leads directly to a stone crusher, G. This reduces the stones to a uniform size, discharging the fragments into a series of scoops on an endless belt, H, which raises them into the hopper E, where they join the gravel delivered from the cylinder D. The cement is hoisted by derricks to the top of the house and dumped into a hopper at I. The hoppers C, I, and E are brought together at one point, K, the ends of the hoppers being fitted each with two valves so placed that definite proportions of the sand, gravel, and cement can be measured as they are passing. The mixture drops into the hopper K, and from there into a sheet-iron rectangular cylinder or prism, L, in constant rotation, through the length of which is a large water-pipe pierced with holes at frequent intervals, which supplies the necessary water for the concrete. The finished mixture is finally dropped out at the end of the cylinder L into buckets, M, which, as fast as filled, are conveyed away by derricks to the spot where they are wanted on the works. In operation, one workman is stationed on top of the house to take care of the vats A and I; three workmen are placed on platform N to take care of the valves at K; a fifth man is required at the stone crusher; and a man is needed at the end of cylinder L to regulate the amount of water delivered to the concrete; in addition to which an engineer is required to operate the steam engine which is placed on platform N, and supplies the motive power operating the two cylinders, the stone crusher, and the belt lift; seven men in all being required.

This mixer has a capacity of from 250 to 300 bbls. of cement per day, equivalent to about 1,000 to 1,200 bbls. of finished concrete, the concrete used on the subway works being mixed in the ratio of one part Portland cement, two and a half parts sand, and four parts of broken stone or gravel.

ENAMELED BRICK FOR THE SUBWAY.

WHILE the Boston Rapid Transit Commissioners have been making experiments with Keene's cement plastering and Portland cement, to determine whether one of these materials may not be as satisfactory as enameled brick for lining the walls of the Boston Subway, the question has been decided in very short order under similar conditions elsewhere. What is to be known as the Blackwell Tunnel is being constructed in London under the bed of the Thames, connecting the densely populated districts of the city below the Tower. There seems to have been no doubt about what material to use for facing the interior of the tunnel. It will be lined throughout, approaches and all, with white enameled bricks and tiles, and it is proposed to wash it down thoroughly with a hose every morning. There is no reasonable doubt that this is the cleanest, most cheerful, and most enduring finish which can be devised for such constructions, and there is no reason why our Transit Commissioners should longer hesitate in their choice.

CEMENT AFFECTED BY FREEZING.

IT appears to be ascertained as a fact, based on more than six thousand recorded results, that Portland cement mortar suffers no surface disintegration under any condition of freezing, but that in most cases its strength is reduced, in some cases by as much as 40 per cent. Rosendale cement is disintegrated when exposed to frost while setting, and its cohesion may be entirely destroyed by immersion in water, which becomes frozen around it. Salt water prevents this disintegration to a large extent, but seems to have an injurious effect upon the strength, and the cement below the disintegrated surface is stated to be increased in strength when the Rosendale cement is used. A mixture of a natural-rock cement and of Portland cement is found to give very satisfactory results, as its surface does not disintegrate, and its strength is increased by the freezing. Portland cement is injured less proportionately as the percentage of the cement in the samples is reduced. Again, though lime mortar is ruined by alternate thawing and freezing, fairly good results may be looked for in the case of brick masonry when the mortar is kept frozen for some time after laying. — *The Railway Review.*

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

CHICAGO. — Chicago's new census leaves the population still below the 2,000,000 mark. But though not as yet the metropolis of the country, this city boasts achievements in many lines aside from pork packing. Her public library has issued more books, by far, this year than any other library in the country. And when the new library building is ready, another stride will be taken. Her Art Institute, though not richly endowed, has accomplished much. Visitors to the galleries of the Institute have aggregated more than those of any other museum, attendance on single days sometimes exceeding 10,000 persons. Students in the Art School of the Institute have numbered this year 1,200. Figures are dry, but some in connection with this marvelous art school are interesting. Of the 650 day students this year, 190 were men. Of the 511 night students, 98 were women. Of the 39 architectural students, 1 was a woman. In the designing (interior decoration) class there were 8 men and 67 women.

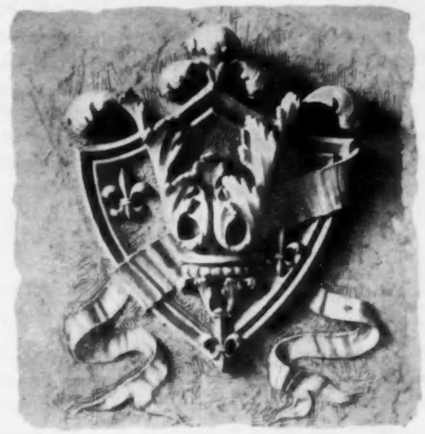
EXECUTED IN TERRA-COTTA BY THE NORTH-WESTERN TERRA-COTTA COMPANY.

The Art School is taking on a more advanced character than formerly, many of the students having taken a long preliminary course of study for their life's work as artists. The school is not for amateurs to do a little dabbling. One evidence of this is the fact that next year the Director of the Institute will announce a prize of $200 for the student who excels in composition. Each competitor for the honor will have to show a series of several paintings.

The Architectural Department of the school is making a very creditable display of students' work. With all the advantages, both of the Art Institute and the Armour Institute, there will soon be an architectural school, far beyond 39 in number of students, and worthy to meet the urgent demand for architectural training. There is an immense constituency beyond the influence of Columbia, Cornell, and Boston Technology.

TERRA-COTTA CAPITAL, BURNHAM ATHENÆUM, CHAMPAIGN, ILL.
J. A. Schweinfurth, Architect. Made by Perth Amboy Terra-Cotta Company.

Building reports continue to be slow. There is some activity now in the down-town district. In addition to the numerous alterations of old buildings, and the tearing down of the old government building, and the destruction of half the Grand Pacific Hotel to make way for the new Illinois Trust Bank Building.



MEDALLION FOR RESIDENCE, PHILADELPHIA.
Baker & Dallet, Architects. Made by Conkling Armstrong Terra-Cotta Company.

The Merrimac, a large office building, by D. H. Burnham & Co., is about ready for basement columns. The exterior of this building, it is said, will be glazed terra-cotta.

The steel frame for the new Ashland Block, J. A. Rogers, architect, is rising.

The Silversmiths' Building, which is to be occupied by jewelers and silversmiths exclusively, is under construction.

The Trude Building has reached its roof.

Referring again to the Grand Pacific Hotel, the other half of the building, which belongs to L. Z. Leiter, will be remodeled by Jenney & Mundie, and will be leased for a hotel. Though made of only half a hotel, with some two hundred rooms, it will be a very respectable whole one.

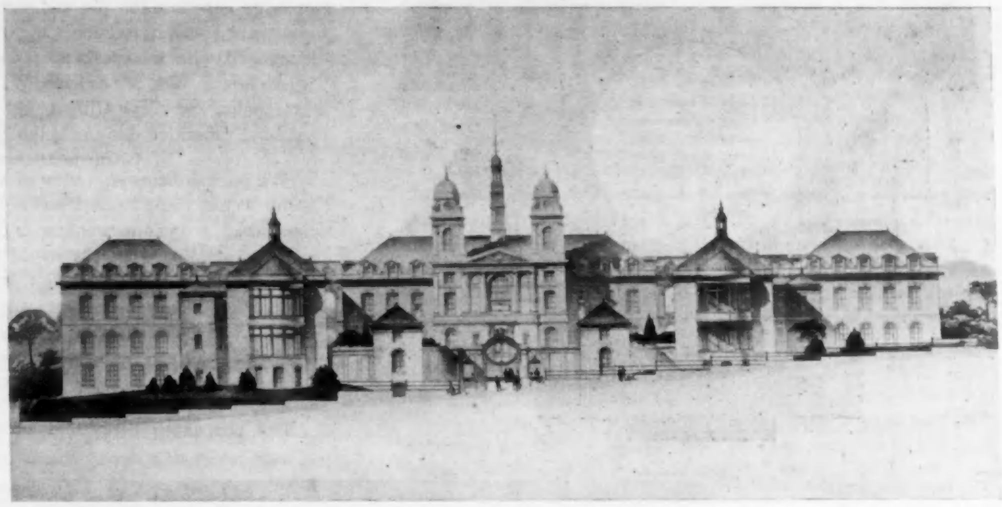
Among building announcements may be noted a $40,000 residence by Shepley, Rutan & Coolidge; one of nearly the same cost, by Chas. S. Frost; bids are being taken on a church by Patton & Fisher; permit has been taken out for the Alexian Brothers' Hospital (four stories, and 175 by 260 ft. in plan) which was planned by Richard E. Schmidt.

ST. LOUIS.—Notwithstanding the efforts of the newspapers to convince us there is more building being done here than during any previous season, and there promise of greater things for the future, the fact remains that there are few architects or builders but who are complaining of dull times, and who speak very discouragingly of the prospects for the future.

A few weeks ago there was a feeling that the worst had passed, and that with the coming of fall business would have assumed its normal condition. But even this faint gleam of hope has been dissipated by the general feeling of uncertainty. Several large factory and other important buildings which were contemplated have been laid over until the results of the coming election are known, while others have been abandoned altogether, even after work had commenced.

There is much of the city which was destroyed by the late storm that has not been rebuilt yet, and much which will not be for a long time to come.

The residence portion of the city visited by the late storm was mostly occupied by those in moderate circumstances, who, after years of toil, had saved enough to build or buy themselves a home, which in many instances were not fully paid for. Very few of them carried tornado insurance, and, consequently, to provide the means to rebuild will take time.

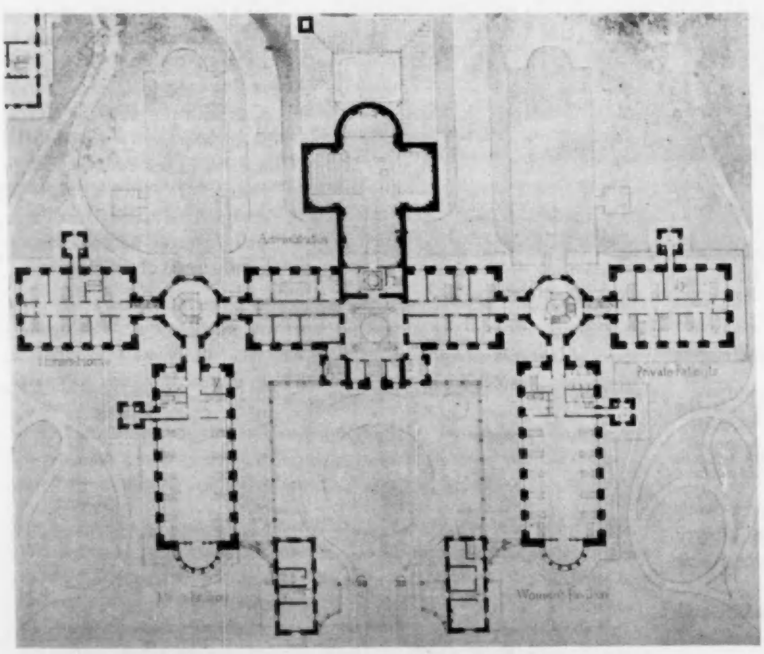


ST. MARGARET MEMORIAL HOSPITAL, PITTSBURG, PENN.
Ernest Flagg, Architect.

The Ives Bill, limiting the height of buildings to 125 ft., which was defeated in the City Council a short time ago, has been again introduced into the House of Delegates in practically the same form as before, excepting that the height is limited to 150 ft. Its passage is being vigorously opposed by the real estate men, but there does not seem to be the same amount of opposition to this bill as to the former.

Permits have been taken out for buildings which, if built, would far exceed this limit, but it is not thought that many of them will, at least not at an early day; but the permits, if they will hold good, might prove good investments as speculative mediums should the ordinance pass.

Among those who have taken time by the forelock are the Holland Building Company, who are at present building the Holland Building on 7th Street, which was mentioned in a former letter.



ST. MARGARET MEMORIAL HOSPITAL, PITTSBURG, PENN.
First floor plan. Ernest Flagg, Architect.

They have taken out a permit for a fourteen-story building on the corner of 7th and Olive Streets, which would form a part of the building now being erected.

Improvements in the vicinity of Cupples Station continue, architect J. L. Wees having just completed plans for a large building on 7th Street and Clark Avenue.

Mr. Wees is also preparing plans for the Scottish Rite Cathedral, to be built on the property recently acquired on Locust Street by that organization.

The old landmark at the corner of Broadway and Pine Street, for so many years occupied by Finney & Hull, is being rebuilt by Architect Isaac Taylor. The same architect is also putting up a five-story wholesale and warehouse at the corner of Broadway and Clark Avenue, for Mr. Andrew Gay.

On 4th and Vine Streets, Shepley, Rutan & Coolidge are erecting a seven-story building for Mr. Henry Hitchcock, at a cost of $125,000. The building is being constructed of gray brick and terra-cotta, and of the slow combustion type in construction. The building is exceptionally well adapted to commercial purposes, being one of the few locations where a building of medium size is favored with street exposure on three sides.

The building which the same firm is putting up on Washington Avenue, at a cost of over $200,000, for the Lindell Real Estate Company, has reached the fourth floor. It is also of gray brick and terra-cotta and slow combustion.

Architect F. C. Bonsack has prepared plans for extensive improvements to the Masonic Home on Delmar Avenue. He also has under construction at Granite City, Ill., an eight-room brick schoolhouse, and fifty houses for the St. Louis Stamping Company, and has just completed a lot of twenty-five houses there for the same company.

PITTSBURG. — New building operations are at a standstill mainly among the larger and better class of buildings.

The Carnegie Steel Company has decided to build a $1,000,000 addition to its already extensive plant.

An elaborate plan is being pushed to erect a $50,000 market house in the East End district.

Made by the White Brick & Terra-Cotta Company for residence on Fifth Ave., New York City. Jardine, Kent & Jardine, Architects.

The congregation of the Third Presbyterian Church has appointed a committee to take steps towards the erection of a new church; competitive drawings will be asked.

Architect T. H. Scott has prepared plans for a three-story brick colonial building on Penn Avenue, to be used as a museum and hall for "Daughters of the American Revolution."

Two apartment buildings will be erected in Allegheny this season, one after plans of Architect F. C. Sauer, and the other of Architect J. A. Jacobs.

Architect W. S. Fraser has prepared plans for a $12,000 colonial residence for Mr. Dawes, at New Brighton.

Architect Joseph Stillberg has prepared plans for an engine house for the Thirteenth Ward, Allegheny.

Architect W. A. Thomas is the successful competitor for the municipal hall and engine house at Rankin.

Architect J. N. Campbell has prepared plans for a brick schoolhouse at Canonsburg.

Architects Bartberger & East are preparing plans for a bank building for the State Bank of Pittsburg, to be erected on Liberty Avenue. They are also preparing plans for a brick schoolhouse at Monongahela City.

Architect F. C. Sauer is preparing plans for a schoolhouse and convent for the Sisters of Saint Stanislaus.

MINNEAPOLIS.— Politics seem to have had a most depressing effect on our midsummer business, and until matters are more definitely settled, a number of important building projects will be side tracked; among them a number of large grain elevators. These, no doubt, will be built before the season ends, however.

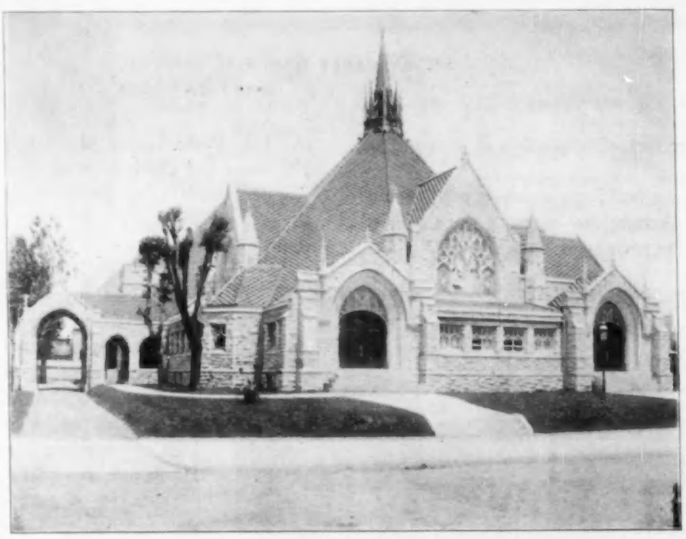
Westminster Church, C. E. Sedgwick, architect, will be pushed to completion, the plans being about finished. It is to be built of dark St. Louis pressed brick with brownstone trimmings. Cost, $85,000.

Orff & Joralemon are architects for the new school building at Decorah, Iowa. Cost, $25,000.

The Northwestern Mantel Company, of Minneapolis, has secured two large contracts for tile and mantel work; one in Park Office Building, at Pittsburgh, Penn.; the other in Great Northern Hotel at Chicago, Ill. Each contract amounts to several thousand dollars.

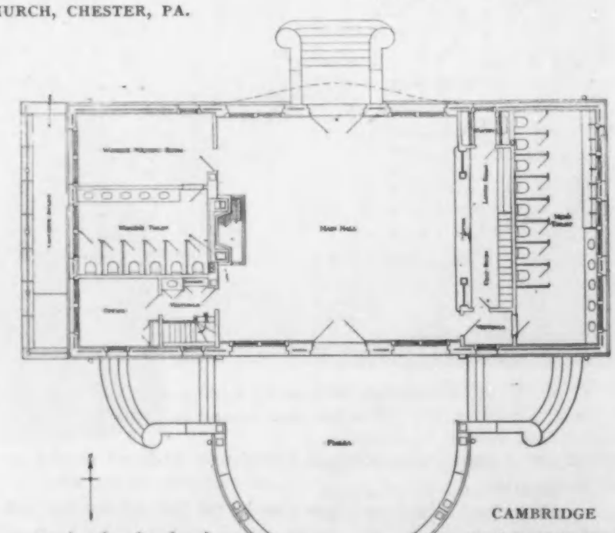
Architects Wm. M. Kenyon, W. H. Dennis, and S. J. Bowler, of Minneapolis, and Cass Gilbert and Herman Kretz & Co., of St. Paul, have submitted designs in the Montana Capitol Competition.

WE publish herewith a view of the Third Presbyterian Church, Chester, Penn., Isaac Pursell, architect. The design is an agreeable treatment of a modern problem in church building. The mass is quaint and pleasing. The details of the stone work are carried out in the perpendicular period of Gothic. The general effect is greatly enhanced by the use of Conosera tiles, which were furnished by the Celadon Terra-Cotta Company, Charles T. Harris, Lessee. There is a quality of color and permanency obtained by the use of these tiles which can be acquired in no other way.



THIRD PRESBYTERIAN CHURCH, CHESTER, PA.

THE plan shown herewith is of the new Park Shelter for Cambridge Field, Cambridge, Mass.; Andrews, Jacques & Rantoul, architects. It will be seen, by referring to plates 38 and 41, that excellent results have been obtained in the texture of the wall by introducing courses of all red brick with the courses having black headers. The batter is laid up in one pattern, the main wall above the batter to the tops of the first-story windows in a second, and the frieze in a third. The bricks are laid with a wide joint troweled off flush with the wall, the mortar being white. By varying the number of red courses, a large variety of patterns may be obtained situable for large wall surfaces without changing the style of the bond.



FLOOR PLAN.

CAMBRIDGE FIELD SHELTER.

ITEMS OF PRACTICAL VALUE.

THE NEW YORK ARCHITECTURAL TERRA-COTTA COMPANY received the following letter from Messrs. Pierce & Bickford, architects of the new City Hall at Elmira, N. Y., for which this company made the terra-cotta: —

"Your favor enclosing photograph of the sculptured panels in each of the pediments of City Hall, and photograph of the column, received. The work is the finest of the kind we have ever seen; in fact, the terra-cotta for the City Hall throughout has excited universal admiration, and it will be a piece of work that you have good reason to feel proud of when the building is completed."

By the same mail came another spontaneous and highly eulogistic reference to this company's work from Mr. A. H. Kipp, Wilkesbarre, Penn.: —

"Permit me to express my gratification and pleasure in the work you have done for the public school being erected in this city under my direction. The terra-cotta is as near perfection as mortals can make it. The string-courses are even, and the pieces fit perfectly. If there be any criticism that is adverse, it might possibly be said that the foliage in tower frieze has a little too much relief, considering the height from street, which is but 70 ft. However, this is a small fault — there are spots on the sun."

While this speaks well for the progress already made in a comparatively new industry, it is but a foretaste of what is yet to come artistically, as well as in reliability and mechanical fitness. In regard to the relief of ornament, we would say that boldness is a good fault in a frieze.

THE WHITE BRICK AND TERRA-COTTA COMPANY, New York, has just completed the terra-cotta for the large Sampson Building, Wall Street, for the Duchess De Dino, Clinton & Russell, architects; and have during the last month closed the following contracts: Residence for P. Tiffany, Esq., Westbury, Long Island, W. J. Wallace, architect; factory building, Altoona, Penn., W. L. Plack, architect; Holloway Building, Norwich, Conn.; six residences, E. 82d Street, New York, Mortimer P. Thain, architect; Irving Savings Bank Building, Chambers Street, New York, Thomas R. Jackson, architect; Store Building, Broome Street, New York, L. Korn, architect. The prevailing color in all this work is white or Indiana lime-stone shade.

THE DONNELLY BRICK AND TERRA-COTTA COMPANY, of Berlin, Conn., will supply the terra-cotta for the Methodist Episcopal Church at Newton, Mass., Cram, Wentworth & Goodhue, architects; Mitchell & Sutherland, builders. Engine House, Fall River, Mass., J. M. Darling, architect; J. O. Wagner & Co., contractors. Working Woman's House, Lowell, Mass., Keely & Houghton, architects; Conners Brothers, contractors. Bartlett Street School, Lowell, Mass., Stickney & Austin, architects; P. O'Hearn, contractor. High School, Lawrence, Mass., P. Regan, architect; Driscoll & O'Brien, contractors.

WALDO BROTHERS, Boston, are furnishing the Brooks, Shoobridge & Co.'s brand of Portland cement in the new reservoir for the city of Cambridge; also for work being done at Malden, Mass.; and the new warehouse on Huntington Avenue, Boston, of which Andrews, Jaques & Rantoul are the architects.

The same company is also supplying the Hoffman cement and West Kent Portland cement to all sections but one on the Metropolitan Sewer running from Dedham to Neponset, Mass.

THE NEW JERSEY TERRA-COTTA COMPANY will supply the architectural terra-cotta for the Y. M. C. A. Building, Cambridge, Mass.; Masonic Building, Newton, Mass., Hartwell, Richardson, & Driver, architects; the Princeton, N. J., Bank, W. E. Stone, architect; apartment house, Madison Avenue, New York City, Henry Andersen, architect; the German Herald Building, New York City, Louis Korn, architect; Phœnix Bank Building, Brooklyn, N. Y., Wm. H. Beers, architect.

G. R. TWITCHELL & Co., Boston, are supplying their red brick for the new storage warehouse, Huntington Avenue, Boston, Andrew, Jaques & Rantoul, architects; Chase Building, Boston, Loring & Phipps, architects; new factory for the American Wringer Company, Woonsocket, R. I., Martin & Hall, of Providence, architects; Working Woman's Home, Lowell, Mass., Keely & Houghton, of Brooklyn, architects; Bartlett Street School, Lowell, Mass., Stickney & Austin, architects.

G. R. TWITCHELL & Co., Boston, have supplied two hundred and fifty thousand gray mottled bricks for the Gate of Heaven Church, South Boston, Geo. B. Clough, architect; also the gray bricks for the SS. Peter and Paul Roman Catholic Church, Fall River, Mass., Cram, Wentworth & Goodhue, architects; and their buff brick for a business block at Somersworth, N. H., Geo. Brown, Dover, N. H., architect.

THE roofing tile made by the Celadon Terra-Cotta Company, Charles T. Harris, Lessee, has been specified on the following work: Boat house and shelter for Lincoln Park, Chicago, J. C. Llewellyn, architect. Grant Memorial Building, Columbus, Ohio, Elah, Terrell, & Co., architects. Lackawanna Country Court House, Scranton, Penn., T. I. Lacey & Son, architects. Passenger station for the Erie Railway Company, Middletown, N. Y., G. E. Archer, architect.

THE white brick made by the White Brick and Terra-Cotta Company, New York, has been specified on a large job at Somerville, Mass. These bricks are made from clean white clay, and are neither sprayed nor dipped. The success that this company has had with white brick and terra-cotta has induced them to go into the manufacture of all other colors of brick.

THE enameled bricks manufactured by the Somerset & Johnsonburg Manufacturing Company, Somerset, Mass., are being used in the Warren Chambers Building, Boston, Ball & Dabney, architects; and for the subway work being done by the N. Y., N. H. & H. R. R. at the following places in Massachusetts: Campello, Heath, Boylston, Jamaica Plain, and Forest Hills.

THE POWHATAN CLAY MANUFACTURING COMPANY, of Richmond, Va., are supplying their cream-white bricks for two flat houses East 72d Street, New York City, Neville & Bagge, architects; four flats on 176th Street, New York City, David W. King, architect; also for thirty residences at Washington, D. C.

THE BUILDERS' & TRADERS' EXCHANGE, 63d and Halsted Streets, Chicago, have a department given up to the exhibition of modern building materials. They would be glad to have sent them for this purpose manufacturers' samples, price-lists, and catalogues. Address, T. P. Hughes, Secretary.

WILLIAM CONNORS, Troy, N. Y., manufacturer of American Seal Mortar Colors, has established the following branch houses: James C. Fagan, 9 Peck Slip, New York City; Stockroff & Co., 407 North 12th Street, St. Louis, Mo.; J. L. Perkins & Co., 243 Lake Street, Chicago, Ill.

THE PIONEER FIRE-PROOF CONSTRUCTION COMPANY, of Chicago will supply their material for the road-ways and foot-passages of six viaducts to be built on the Lake Front Park for the Illinois Central Railroad; J. J. Wallace, chief engineer.

WALDO BROTHERS, Boston, furnished Alsen's Portland Cement for all the work done in Section 1 of the Boston Subway, and also for part of the work on three other sections that have been let.

THE CLEARFIELD CLAY WORKING COMPANY, Clearfield, Penn., are furnishing the brick for public school buildings in their city, also for a church at Philipsburg, Penn.

THE new Coe Building, on Broadway, New York City, of which Geo. B. Post is the architect, will be fire-proofed by the Pioneer Fire-proof Construction Company, of Chicago.

THE UNION AKRON CEMENT COMPANY, of Buffalo, N. Y., are furnishing the cement for concrete foundation for street paving at Erie, Penn.

THE CHEMISTRY OF POTTERY,

BY KARL LANGENBECK,

Superintendent of the Mosaic Tile Company, Zanesville, Ohio, formerly Superintendent of Rockwood Pottery, Chemist of the American Encaustic Tiling Company, etc., Easton, Penn.; Chemical Publishing Company, 1895. *Price,* $2.00.

ANY one who has read the account of the years of patient experimenting and discouraging failures which preceded the successes of Bernard Palissy, the famous French faience artist, can fully appreciate why the secrets of the manufacture of every-day pots and dishes and terra-cottas, which are now so commonplace, were once so jealously guarded. It has, however, been reserved for later investigators than Palissy or the Meissen potters to analyze and classify the physical and chemical properties of burnt clay. Under the title of "The Chemistry of Pottery," Mr. Langenbeck has collected and arranged in a convenient little volume a synopsis of the facts regarding the composition and the properties of porcelain, faience, and the terra-cottas, including complete chemical analyses of the various clays, coloring matters, glazes, and enamels. Such a work is necessarily technical to a very high degree, but the technicalities are such as every intelligent potter will be glad to possess in so tangible and available form. We are so truly creatures of habit that we are often too slow in using our technical aids. Conditions imposed by chance are in the majority of cases accepted as inevitable to the manufacture, and no systematic effort is made to readjust and correct them; and while it is true that mere analyses of materials are of little or no avail in the solving of such problems, the training of the technical chemist fits him better to carry out systematically the many empiric trials necessary for the readjustment of the conditions or their proper establishment originally. This is the *raison d'être* of Mr. Langenbeck's book.

Of the portions directly relating to architecture, there are valuable chapters on majolica and enameled tile, on white enameled brick, and on floor tile and terra-cotta. The book is comprehensively arranged, concisely written, is free from abstract theories, and is thoroughly cross-indexed. It is a valuable addition to the limited literature upon the subject.

BRICK WALLS.

THE logic of common sense is the best form of reasoning, and the soundness of any theory must be confirmed by practise, or our judgment may be led astray.

Take the front and sides of a brick building, for instance, and we shall find that about one fifth part of the entire surface of the walls is composed of mortar, and should a wall become disintegrated by collapse, we shall find that the mortar (in the majority of cases), instead of cleaving to the brick as a cement should do, falls off like a powder, leaving the brick bare as when it left the brick-yard.

Common sense will then tell us that the mortar used in laying brick is a more important factor in the construction of a durable wall than the brick itself, and as such should be composed of the very best ingredients to effect that result.

Every builder knows that lime and sand are the principal constituents of mortar, and the finer the sand the better the cohesion, as it is rendered less porous, a very important element.

The "American Seal" brick and mortar colors are the product of a practical cement and paint maker, Mr. William Connors, of Troy, N. Y., who has given much study to the subject. When combined in the mortar they act as a mordant or binder on account of their almost impalpable fineness, being ground by machinery, and the coloring matter which they contain will not run, fade, or streak the building, and the various beautiful tints with which they are colored add artistic beauty to the appearance of a wall. They combine beauty with utility, and give to a brick front a very handsome appearance. They are made in five tints, — Milwaukee, terra-cotta, black, red, and brown.

The celebrated Assyriologist Layard, in describing the existing ruins of the tower of Babel (erected about 2247 B. C.) states: "The fire-burnt bricks of which it is built have inscriptions on them, and so excellent is the cement, which appears to be lime-mortar, that it is nearly impossible to extract one whole."

Many houses are rendered damp and unhealthy through what is called "sweating of the walls," but which is really due to porosity of the mortar, which is used in laying the brick. It is often claimed that frame houses are drier and healthier than those composed of brick and mortar, and why is it so? We answer — poor mortar.

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Representation of a FIREPLACE MANTEL. Our Sketch Book, containing 39 others, will be sent you on application.

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In such Colors as Red, Cream, Buff, Pink, Brown, and Gray. These Mantels cost no more than other kinds, but are far better. They are easily set, and have a richness and simplicity of effect which is decidedly pleasing.

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